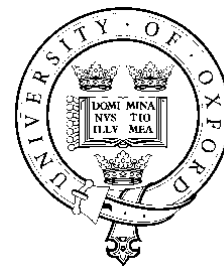


Oxford Poverty & Human Development Initiative (OPHI)  
Oxford Department of International Development  
Queen Elizabeth House (QEH), University of Oxford



# OPHI RESEARCH IN PROGRESS SERIES 54b

## Multidimensional Poverty Reduction in India 2005/6–2015/16: Still a Long Way to Go but the Poorest are Catching Up

Sabina Alkire\*, Christian Oldiges\*\* and Usha Kanagaratnam\*\*\*

July 2020

### Abstract

Following Amartya Sen's pioneering ideas on poverty and inequality measurement, the development economics literature proposes diverse classes of measures as well as poverty orderings. Yet in the Sustainable Development Goals (SDGs), the headcount ratio is the primary statistic for measuring monetary and multidimensional poverty. Rigorously analysing the trends of multidimensional poverty for India between 2005/6 and 2015/16, we illustrate how the headcount ratio is not able to observe certain centrally important requirements of the SDGs – such as whether anyone is being left behind, or how deprivations are interlinked. We propose using the adjusted headcount ratio or Multidimensional Poverty Index (MPI) as the primary poverty measure for policy assessment, supplemented by the headcount ratio, intensity, number of poor, and composition of poverty, to provide more accurate analyses. Exploiting cross-sectional data comprising of more than three million individuals and a panel of 29 states and several socio-economic subgroups, we show empirically how the reduction of multidimensional poverty by 271 million unfolded within a decade. In contrast to earlier periods in time, we find that the poorest of the poor saw the largest reductions in multidimensional poverty due to falling levels of intensity – a feature the headcount ratio alone cannot portray. Despite the importance of the MPI we also recognise the inherent and enduring need to probe the headcount ratio and number of poor statistics. Hence we corroborate these stark findings with an assessment of the dominance of the distribution of attainment scores which establishes the relationship between MPI and H in both periods. To assess the robustness, 19 additional MPIs are constructed, having different indicator definitions and combinations, and it is found that in nearly all of these a greater number of persons left poverty.

\* Director, Oxford Poverty and Human Development Initiative (OPHI), Department of International Development, University of Oxford, [sabina.alkire@qeh.ox.ac.uk](mailto:sabina.alkire@qeh.ox.ac.uk)

\*\* Director of Policy, Oxford Poverty and Human Development Initiative (OPHI), Department of International Development, University of Oxford, [christian.oldiges@qeh.ox.ac.uk](mailto:christian.oldiges@qeh.ox.ac.uk)

\*\*\* Senior Research Officer, Oxford Poverty and Human Development Initiative (OPHI), Department of International Development, University of Oxford, [usha.kanagaratnam@qeh.ox.ac.uk](mailto:usha.kanagaratnam@qeh.ox.ac.uk)

This paper is part of the Oxford Poverty and Human Development Initiative's Research in Progress (RP) series. These are preliminary documents posted online to stimulate discussion and critical comment. The series number and letter identify each version (i.e. paper RP1a after revision will be posted as RP1b) for citation.

For more information, see [www.ophi.org.uk](http://www.ophi.org.uk).

**Keywords:** India, poverty measurement, multidimensional poverty, disaggregation, Inter-temporal poverty reduction, NFHS-4, NFHS-3, child poverty, caste, religion, state, poverty dominance, robustness.

**JEL classification:** I3, I32, O1, O5, O53

**Acknowledgements:**

We thank Kaushik Basu, Mihika Chatterjee, Angus Deaton, Jean Drèze, Aparna John, Amartya Sen, and Yangyang Shen for very helpful advice on various sections of the paper that is still in progress and is yet to fully incorporate all their ideas. We are very grateful to Rubeena Mahato and Aparna John for patient research assistance and to participants in academic seminars, and in the HDCA and World Bank 2019 conference, whose insights and comments strengthened this paper.

**Funding information:**

The authors are grateful for support of the research underlying this paper from ESRC-DFID ES/N01457X/1, DFID for project 300706 and Sida Project 11141. All errors remain our own.

**Citation:** Alkire, S., Oldiges, C. and Kanagaratnam, U. (2020). ‘Multidimensional poverty reduction in India 2005/6–2015/16: Still a long way to go but the poorest are catching up’, OPHI Research in Progress 54b, Oxford Poverty and Human Development Initiative, University of Oxford.

## 1. Introduction

In his 1976 article *Poverty, an Ordinal Approach to Measurement*, Sen argued that inequality among the poor should be considered in poverty measures that informed public policy. The article initiated a large literature proposing different classes of measures, as well as assessing poverty orderings. Yet in the Sustainable Development Goals, the headcount ratio remains the primary statistic for measuring monetary and multidimensional poverty. Does this matter?

Rigorously analysing the trends of multidimensional poverty for India 2005/6 to 2015/16, this article illustrates how the headcount ratio is not able to observe certain centrally important requirements of the SDGs – such as whether anyone is being left behind, or how deprivations are interlinked. We propose using the adjusted headcount ratio or Multidimensional Poverty Index (MPI) as the primary poverty measure for policy assessment, supplemented by the headcount ratio, intensity, number of poor, and composition of poverty, to provide more accurate analyses.

Counting-based methods to measure multidimensional poverty are the most widely used in public policy because they can be rigorously applied using ordinal and dichotomous data (World Bank 2017, Atkinson 2019). Using counting-based methodologies, two measures are widely reported: the headcount ratio of people who experience a minimum number of deprivations (Nolan and Whelan 2014, Eurostat 2020), and the adjusted headcount ratio (Alkire and Foster 2011).<sup>1</sup>

The MPI includes the headcount ratio (H) as a partial index, hence the headcount ratio will always be reported, and should be used to convey important information that the MPI lacks such as the number of people who moved out of poverty. However just as the headcount ratio overlooks the poverty gap and squared gap, so too the MPI also assesses ethically vital and empirically significant information to which the headcount ratio is completely blind.

<sup>1</sup> As is natural for an emerging literature, there are many methodological considerations to clarify, and this paper is one of a set of papers that use extensive empirical analyses to better understand a set of entwined methodological issues. Alkire, Kanagaratnam, Nogales, and Suppa (2020) extend on earlier work on robustness of the global MPI (Alkire and Santos 2014) and respond to the suggestion in World Bank (2017) to generalize robustness to the full spectrum of weights. A related paper by the same authors (2019) documents how the union identification strategy favoured by Aaberge and Brandolini (2017), Pattanaik and Xu (2018) and Datt (2018) among others generates results that are highly sensitive to the choice of indicators. Further work on the topic of inequality among the multidimensionally poor (Alkire and Foster 2016, mimeo) establishes the fundamental importance of dimensional breakdown because Shapley decomposition is difficult to interpret with hierarchical weights. But it also establishes the impossibility of creating any single measure that both can be broken down by indicator and reflects inequality among the poor. While it proposes a class of measures that build upon Chakravarty and D'Ambrosia 2006 among others, new information that the inequality-respecting measure in that class adds, over and above the adjusted headcount ratio, is, at least on first inspection, modest.

In this paper, we show that two relationships that are fundamental to the SDGs can be addressed by the MPI and not the headcount ratio. First, in terms of leaving no one behind – a fundamental motivation of disaggregated analyses – this paper shows that the results using the H clash with MPI. According to H, the poorest states did not progress the fastest; according to the MPI they did. We show that this occurred because the reduction of intensity among the poor was swiftest among the poorest groups. The headcount ratio is blind to progress among the poor, so misses it, making results in this case, inaccurate. To further examine the robustness of this important finding the paper illustrates a new assessment of the dominance of the attainment distribution and finds poverty dominance. Second, SDG strategies replace policy silos with integrated policies for interlinked indicators, hence requiring information on which indicator reductions drive change. This is elementary for the MPI, because any reduction in any deprived indicator of a poor person reduces MPI. But the headcount ratio lacks any direct association of this kind.

Despite these blind spots, the headcount ratio has a powerful ongoing salience because it is familiar, and groups deprivations at the level of each person. So there will rightly be an demand to report the headcount ratio and derived statistics such as the number of persons who left poverty. To support such analyses, this paper goes beyond the well-known assessments of robustness to the poverty cutoff and weights, and illustrates how to assess the robustness of ‘number of poor’ results (in this case that some 270 million people moved out of poverty in a decade) to different indicator definitions and combinations.

To illustrate these points, building on previous work, particularly a study of the global MPI trends 1998/99 to 2005/6 (Alkire and Seth 2015),<sup>2</sup> this paper assesses the change in multidimensional poverty in India from 2005/6 to 2015/16 using data from the third and fourth rounds of the National Family Health Survey (NFHS) series.<sup>3</sup> and <sup>4</sup> Estimates of changes are disaggregated by state, urban-rural area, age cohort, and socio-economic group-level, and considered alongside sampling errors. In each case we

<sup>2</sup> As an interesting triangulation, using the Chakravarty and Di’Ambrosio (2006) class of measures with 13 indicators from three rounds of NFHS data, and comparing these trends with monetary trends from the National Sample Survey, Mishra and Ray (2013) also observed a smaller decline in multidimensional poverty among India’s most deprived caste – the scheduled caste and scheduled tribes compared to other socioeconomic groups.

<sup>3</sup> An earlier “research in progress” version of this paper is available as Alkire, Oldiges and Kanagaratnam, 2018; cf OPHI, 2018 Chapter 2. Since then, minor modifications have been applied, namely additional changes in data cleaning and slight revision to the child mortality indicator. These changes are transparently detailed in Alkire, Kanagaratnam and Suppa, 2019 (p. 25). There are minor differences between the results published in 2018 and in this paper, but the overall findings are not affected.

<sup>4</sup> The global MPI methodology has been applied in Alkire, Kanagaratnam, Nogales and Suppa (2020) for understanding the robustness of the methodology across 105 country datasets; Alkire, Kovesdi, Mitchell, Pinilla and Scharlin-Pettee (2020) for comparison over time across 80 countries; Jindra and Vaz (2019) for understanding the association between good governance and poverty in 71 countries. In addition, the global MPI methodology has been adapted and/or extended in Ogotu and Qaim (2019) for Kenya; Suppa (2018) for Germany; Hanandita and Tampubolon (2016) for Indonesia; Alkire and Aablaza (2016) for Europe using the EU-SILC data.

observe how change happened in terms of the different patterns of reduction in deprivations across ten indicators measured for the same household. The standardisation of the ten indicators in this paper mainly follows the global MPI 2019 specifications (Alkire, Kanagaratnam & Suppa, 2019).<sup>5</sup>

The contribution of this paper is threefold. Going beyond conceptual arguments, the paper illustrates the value-added of using the MPI to track poverty reduction trends rather than using merely the headcount ratio, because in India, the MPI provides indicator level detail and reflects progress in the poorest groups that the headcount ratio cannot see. Empirically, this paper provides a systematic analysis of how much multidimensional poverty reduced in India between 2005/6 and 2015/16, how the level and indicator composition and speed of change varied by region and social group, whether the poorest reduced poverty fastest, and whether the finding is affected by the poverty cutoff. Methodologically, the paper implements two new types of robustness analysis. We consider the population-wide distribution of deprivation and attainment scores and find poverty dominance between the two years. To probe whether the number of poor who left poverty figure is robust to different indicator specifications, data-intensive explorations of poverty reduction for each of 20 alternative specifications of the MPI both establish robustness and illustrate robustness tests to indicator specifications.

The paper proceeds as follows: Section 2 presents the data and methodology. Section 3 presents results for changes in multidimensional poverty across states and socio-economic subgroups, as well as the robustness of these results and dominance relationships. Section 4 focuses on the robustness of the number of people who moved out of multidimensional poverty using multiple trial measures. The final section concludes.

## 2. Data and methodology

### 2.2. NFHS data

The NFHS has been conducted by the International Institute of Population Sciences (IIPS), Mumbai and is the major source for demographic and health indicators in India. With support from the ICF International, and the National AIDS Research Institute (NARI), Pune it is part of the Demographic Health Surveys (DHS) conducted globally. The fourth round of the NFHS was conducted only after an

<sup>5</sup> The global MPI was first developed in 2010 by Alkire and Santos (2010, 2014), in collaboration with the United Nations Development Programme (UNDP, 2010). In 2018, five of the ten indicators of the global MPI were revised following data improvement in more recent household surveys, and adjusted to better align the indicators with the Sustainable Development Goals (Alkire and Kanagaratnam, 2020; Alkire and Jahan, 2018; Alkire, Kanagaratnam and Suppa, 2018; OPHI, 2018). Please note that in some publications, the NFHS surveys are identified as Demographic and Health Surveys (DHS).

interval of ten years. During that time, the absence of reliable microdata in the public domain stymied intertemporal analyses, hence the intense research interest in the fourth round of NFHS microdata.<sup>6</sup>

The NFHS 4 (2015/16) is representative at the state and district level.<sup>7</sup> In contrast, the NFHS 3 (2005/6), is only representative at the state level. The sample size thus increased almost six-fold between NFHS 3 and 4. Both surveys use a two-stage stratified sampling design (IIPS 2007, 2017). This makes the two datasets comparable over time at the state level, albeit not at the district level. Several studies beyond IIPS reports and collaborative studies (NFHS 4, 2016 and NFHS, 2017) have already extensively used the NFHS 4 microdata.<sup>8</sup>

### 1.1.1. Demographic considerations

Assessing the change in MPI for disaggregated units over time using repeated cross-section data is challenging. For example, population shares may have changed due to migration, differential fertility or shocks (both surveys are based on different censuses). Also, demographic changes in the size and composition of households may affect measured poverty. For example, the MPI indicators in health and education reflect the joint attainments or deprivations of household members. If the size or composition of households change considerably in a decade, this is likely to affect the measured frequency and distribution of health and education deprivations.

The analysis presented in Table A.1 (Appendix A) gives an indication of the magnitude of these changes between NFHS 3 and NFHS 4. The differences in population share between the full NFHS sample and the sample retained is small. By comparing the NFHS population shares across the two surveys for rural-urban areas, states, age cohorts, caste and religious groups, as well as household types and compositions, we identify the larger demographic changes, most of which are verified by the 2011 census values. The interpretation of poverty trends must be cognisant of these shifts and further work on this topic is required.

<sup>6</sup> During this period internal exercises were undertaken by some of us with the India Human Development Surveys and with the District Level Household and Facility Surveys. Analyses were not pursued due to uncertainty regarding the rigorous comparability of disaggregated values.

<sup>7</sup> However, despite being representative at the district level, not all indicators of the NFHS 4 can be estimated at the district-level, but only those published by IIPS (2017).

<sup>8</sup> For example, Coffey and Spears (2018) analysed the levels and trends of open defecation. Paul (2019) studied the effects of girls' educational attainment and household poverty on the prevalence of female child marriage at the district-level in India. Dhirar et al (2018) assessed child related health indicators and its progress since the third round of NFHS.

## 2.2. Constructing India's MPI

We construct and estimate the multidimensional poverty over time for India in this paper based on the global MPI methodology. The global MPI is a counting-based measure that reflects the overlapping deprivations that strike members of the same household (Alkire and Foster 2011). It tracks ten deprivations related to three dimensions: health, education, and living standards. In 2018 and 2019, the Oxford Poverty & Human Development Initiative (OPHI) at the University of Oxford and the United Nations Development Programme (UNDP) jointly revised five of the ten original indicators comprising the global MPI which has been published since 2010 by both institutions. The conceptual justification for the indicator revisions is given in Alkire and Jahan (2018), while the technical and methodological specifications can be found in Alkire, Kanagaratnam and Suppa (2018, 2019). The 2019 specifications are used in this paper.

By design, since the indicators are from the same source of survey (NFHS) over two survey periods (2015/16 – 2005/6), they are very likely to be comparable. However, few of the survey questions and subnational coverage were improved or revised over the survey period. This raised comparability issues. Hence careful indicator harmonisation was carried out between the two survey periods to ensure indicator comparability over time. The harmonisation of indicators and subnational units over time is detailed in Appendix B.

An intuitive introduction to the global MPI methodology is as follows.<sup>9</sup> A deprivation profile is created for each person, showing the indicators in which each person is deprived (Appendix B). The ten indicators cover three dimensions: health, education and living standards. The deprivation profile shows, for example, if they lack any of the six indicators of living standards: safe water, adequate sanitation, electricity, clean cooking fuel, adequate housing materials, or asset ownership. It also assesses whether anyone in the household is undernourished, or suffered the death of a child in the last five years (health dimension). In addition, if no household member has completed six years of schooling, or if a child is not attending school up to the age at which they would complete class eight, they are deprived in those indicators (education dimension). The three dimensions are equally weighted; the indicators of health and education thus are each weighted one-sixth each, and the six indicators of living standard are weighted one-eighteenth. A person's deprivation profile is summarised in a deprivation score that adds up the weights on each deprived indicator, and shows what percentage of weighted deprivations that person experiences.

<sup>9</sup> Many technical introductions on the methodology are available. Please refer to Alkire and Foster 2011; Alkire, Foster, Seth, Santos, Roche and Ballon 2015 for example.

Next, following Sen (1976), comes identification of who is poor using a poverty cutoff. If they experience one-third of the weighted deprivations or more, they are identified as MPI poor. Finally, this information is aggregated into the MPI, which sums the deprivation scores of the poor divided by the population. The MPI can equivalently be expressed as the product of the poverty rate (or incidence of multidimensional poverty, or headcount ratio) and the average deprivation score among the poor (or intensity). The MPI is also, equivalently, the weighted sum of the percent of the population who are at once poor, and deprived in each indicator. Hence the MPI can be broken down to show the indicators that comprise it. The MPI and its sub- and partial indices are used with confidence intervals reflecting sampling errors to assess the significance of apparent differences in the level or change of poverty. The detailed formulation of measurement methodology, of assessment of changes over time, including analytical standard errors and their use for statistical inference, and the correct treatment of the sub- and partial indicators, is outlined in Alkire et al. 2015, and demonstrated in previous papers (Alkire and Seth, 2015; Alkire, Roche and Vaz, 2017; Alkire, Jindra, Robles and Vaz, 2017).

### 2.3. Sample drop

Some 4.5 percent of individuals were dropped from the NFHS 4 dataset because they were identified as non-usual residents or had incomplete observations across the ten global MPI indicators. Similarly, around 5.5 percent of individuals from the NFHS 3 dataset were excluded from the final estimation. We exclude the non-usual residents because poverty estimates should accurately capture the situation of permanent householders sharing resources on a permanent basis. We exclude persons lacking data on any of the ten indicators to obtain a comprehensive multidimensional poverty profile of individuals.

The final analytical sample for NFHS 4 (2015/16) covered 2.7 million individuals, that is, 95.5 percent of the original weighted sample was retained. Slightly less than half a million individuals were retained in NFHS 3 (2005/6) or 94.5 percent of the original weighted sample. The sample drop in India NFHS 3 and 4 largely is caused by missing nutrition information among eligible household members. The data identify these individuals as eligible for anthropometric measure. However, a significant number of these eligible individuals are not at home during the survey, are incapacitated or refused to be measured. As such, missing nutrition data led to additional increase in the loss of the weighted analytical sample, from 2.8 to 4.5 percent for NFHS 4 and from 3.5 to 5.5 percent for NFHS 3.

As a result of the data loss, we find that five of the 640 districts in NFHS 4 (2015/16) have a sample loss of more than 25 percent. All five districts are located in Delhi.<sup>10</sup> We find that the sample loss for NFHS

<sup>10</sup> All five districts are located in Delhi. Specifically the sample loss in Delhi Central is 29.93%; Delhi East is 25.53%; Delhi north is 27.85%; Delhi North West is 26.37%; and Delhi South West is 26.35%.



3 (2005/6) data that is representative at the state level reaches 24.3 percent for Delhi, but is below 10 percent in all other states. Evidently, the sample loss for NFHS 4 and 3 is restricted to the Delhi region. We argue that this does not affect the aggregate poverty figures. The definition of household applied in sampling frame itself is limited in the capital of Delhi. The most deprived such as those living in makeshift tents along the road, the homeless, and illegal settlements are excluded by the sampling frame of the surveys, leaving the poorest underrepresented (Lucci et al 2018). For example, across states, Delhi accounts for the lowest poverty level in India, that is, at 4.3 percent in 2015/16 and 12.9 percent in 2005/6. In addition, the non-response rate for anthropometric measurement is highest in Delhi as eligible adults are not at home when measurement is carried out. This is very likely because individuals are at work.

### 3. Results

This section critically analyses the trends in multidimensional poverty because, beyond their direct empirical interest, they illustrate a fundamentally important methodological point – namely the need to go beyond the headcount ratio measure that is profiled in the SDGs if we are interested in exploring interlinkages across indicators and whether anyone is ‘left behind’.

#### 3.1. Changes in multidimensional poverty between 2005/6 and 2015/16

This section presents results for MPI, H, and A for states and socio-economic subgroups of age, religion and caste for the two survey years of 2005/6 and 2015/16. All named comparisons are statistically significant at the 95% level and are reported with confidence intervals, following the suggestions in the Atkinson Commission Report *Monitoring Global Poverty* (World Bank 2017 cf Atkinson 2019).

Due to the large sample sizes in both years, standard errors are small in magnitude. As reported in Table 1, the MPI more than halved between 2005/6 and 2015/16 (0.283 to 0.123), which is a momentous achievement. The incidence of multidimensional poverty – the headcount ratio (H) – reduced strongly but not by half (55.1 to 27.9 percent) – illustrating the cross-cutting theme of this paper, which is how the adjusted headcount ratio or MPI is a more sensitive and accurate tool for capturing society-wide poverty reductions because it also captures reductions in intensity among the poor (51.3 to 43.9 percent). Still, considering only the headcount ratio, a partial statistic, the results show an impressive reduction of the number of poor people by around 271 million.<sup>11</sup> Methodologically we observe that the number of

<sup>11</sup> Note that the 2018 results published in OPHI 2018, and the 2019 results published in UNDP-OPHI 2019 have slightly different figures for India due to minor methodological changes carried out in 2019. However, in both results, around 271 million persons left poverty in India between 2005/6-2015/16.

people leaving poverty is not obtained, however, from MPI but rather is the product of H and the population of India. Yet admittedly such numbers are easy to communicate.

For example, India's scale of multidimensional poverty reduction over the decade 2005/6 to 2015/16 brings to mind the pace of China's reduction of a different kind: monetary poverty reduction, which likewise had global implications. According to the Government of China's 2010 poverty line, the number of income poor in China reduced by a dramatic 297 million between 2000–2010; and by 231 million from 2005–2015, leaving only 56 million in poverty in 2015.

Similarly, Chen and Ravallion (2010) studied China's reduction in poverty rates and number of poor using the international \$1.25-a-day poverty line, and suggested that 267 million people came out of poverty between 1990–2002. But how did India's reduction of MPI come about?

### 3.1.1. Total reduction of deprivations in each MPI indicator

The change in the headcount ratio does not answer the 'how change happened' question. Unlike the headcount ratio, the MPI can be broken down into its component indicators. And there is a direct relationship between each indicator and the MPI: any reduction of any deprivation of a poor person reduced MPI – but not H. Is that important? This section and the next one study patterns of reduction of the indicators. This section scrutinizes trends in deprivations experienced across the entire population in each of the 10 indicators.<sup>12</sup>

Figure 1 illustrates the absolute change in uncensored headcount ratios, as these are called.<sup>13</sup> The original level of deprivation is on the horizontal axis, with the indicators having the highest uncensored headcount ratios towards the right. The vertical axis shows by how many percentage points each indicator was reduced; the line shows the vertical position at which each indicator would achieve zero incidence, thus those closer to the line are closer to zero prevalence.

If we consider deprivations across the population and how they changed 2005/6–2015/16, we observe strong and statistically significant changes in every indicator. Figure 1 indicates that 21.3 percent of Indians lived in a household in which at least one child was not attending school in 2005/6, while it was 6.4 percent in 2015/16 - a 15 percentage point drop (Table C.1, Appendix C). Decreases in nutrition were even stronger: 57.3 percent of people lived in a household in which at least one person was

<sup>12</sup> This section analyses the uncensored headcount ratios of each indicator. We have not applied the poverty cutoff at this stage. The global MPI methodology identifies individuals as MPI poor if they are deprived in 1/3 or more of the weighted indicators. This means even if individuals are deprived in certain indicators but if their total weighted deprived indicators are less than 1/3, then they are non-poor.

<sup>13</sup> Numbers related to Figure 1 are presented in Table C.1, Appendix C.

Table 1 Change in poverty nationally and across population subgroups

	2005/6 (NFHS 3)								2015/16 (NFHS 4)								Absolute Change				Relative Change			
	Pop. Share <sup>1</sup>	MPI	H	A	N poor <sup>2</sup>	Pop. Share <sup>1</sup>	MPI	H	A	N poor <sup>3</sup>	MPI	H	A	N poor	MPI	H	A							
	%	est.	s.e.	%	s.e.	%	s.e.	%	s.e.	%	s.e.	%	s.e.	million	est.	%	%	million	est.	%	%			
National	100.0	0.283	0.003	55.1	0.4	51.3	0.2	640.6	100.0	0.123	0.001	27.9	0.1	43.9	0.1	369.5	-0.160***	-27.2***	-7.4***	-271.0	-56.7	-49.4	-14.4	
<i>Area</i>																								
Rural	69.8	0.355	0.003	68.1	0.5	52.0	0.2	553.0	67.7	0.163	0.001	36.8	0.2	44.1	0.1	330.2	-0.192***	-31.3***	-7.9***	-222.8	-54.2	-45.9	-15.3	
Urban	30.2	0.117	0.004	25.0	0.8	46.8	0.4	87.6	32.3	0.039	0.001	9.2	0.2	42.6	0.2	39.3	-0.078***	-15.8***	-4.2***	-48.2	-66.5	-63.2	-9.0	
<i>States</i>																								
Andhra Pradesh*	AP	7.2	0.236	0.010	50.0	1.7	47.2	0.6	41.9	6.6	0.067	0.002	16.4	0.5	40.8	0.3	14.3	-0.169***	-33.6***	-6.4***	-27.6	-71.6	-67.2	-13.5
Arunachal	AR	0.1	0.313	0.019	60.0	2.9	52.2	1.0	0.8	0.1	0.108	0.004	24.4	0.9	44.2	0.4	0.3	-0.205***	-35.6***	-8.0***	-0.5	-65.6	-59.3	-15.3
Assam	AS	2.7	0.317	0.017	61.7	2.7	51.4	0.7	19.1	2.5	0.162	0.003	36.2	0.6	44.7	0.2	11.8	-0.155***	-25.5***	-6.8***	-7.3	-49.0	-41.3	-13.1
Bihar	BH	8.0	0.449	0.012	77.4	1.4	58.0	0.8	71.6	9.0	0.248	0.003	52.5	0.5	47.2	0.1	62.2	-0.201***	-24.9***	-10.8***	-9.4	-44.8	-32.2	-18.6
Chhattisgarh	CT	2.3	0.355	0.011	70.0	1.6	50.8	0.8	18.4	2.3	0.153	0.003	36.8	0.7	41.5	0.2	11.2	-0.203***	-33.2***	-9.3***	-7.2	-57.1	-47.4	-18.4
Delhi	DL	1.0	0.058	0.007	12.9	1.4	45.0	0.9	1.4	1.2	0.018	0.003	4.3	0.6	42.1	1.1	0.7	-0.040***	-8.6***	-2.9***	-0.8	-68.9	-66.8	-6.5
Goa	GA	0.1	0.088	0.008	20.7	1.8	42.6	0.6	0.3	0.1	0.020	0.004	5.5	1.0	37.2	0.7	0.1	-0.068***	-15.2***	-5.4***	-0.2	-76.8	-73.4	-12.7
Gujarat	GJ	4.9	0.185	0.012	38.3	2.2	48.4	0.8	21.8	4.7	0.092	0.003	21.7	0.7	42.2	0.3	13.5	-0.094***	-16.6***	-6.1***	-8.2	-50.5	-43.3	-12.7
Haryana	HR	1.9	0.187	0.015	39.1	2.5	47.7	1.3	8.8	2.4	0.046	0.002	10.9	0.5	42.5	0.4	3.4	-0.140***	-28.1***	-5.3***	-5.4	-75.1	-72.0	-11.1
Himachal Pradesh	HP	0.6	0.129	0.011	31.1	2.2	41.6	0.9	2.1	0.5	0.030	0.002	8.1	0.5	37.4	0.4	0.6	-0.099***	-22.9***	-4.2***	-1.5	-76.5	-73.8	-10.0
Jammu & Kashmir	JK	0.9	0.193	0.011	41.8	2.0	46.3	0.7	4.5	1.0	0.064	0.003	15.2	0.6	41.7	0.3	2.0	-0.130***	-26.5***	-4.6***	-2.6	-67.1	-63.5	-9.9
Jharkhand	JH	2.7	0.429	0.015	74.9	2.0	57.3	0.8	23.4	2.7	0.208	0.003	46.5	0.6	44.7	0.2	16.4	-0.221***	-28.3***	-12.6***	-6.9	-51.5	-37.8	-22.0
Karnataka	KA	5.5	0.229	0.010	48.9	1.8	46.8	0.7	31.2	4.9	0.069	0.002	17.3	0.5	39.8	0.2	11.1	-0.160***	-31.6***	-7.0***	-20.1	-70.0	-64.7	-14.9
Kerala	KL	2.6	0.053	0.005	13.3	1.1	39.7	0.7	4.0	3.0	0.004	0.000	1.1	0.1	37.3	0.7	0.4	-0.049***	-12.2***	-2.4***	-3.6	-92.4	-91.9	-6.1
Madhya Pradesh	MP	6.5	0.366	0.012	68.7	1.7	53.2	0.7	52.0	6.6	0.182	0.002	41.1	0.4	44.3	0.1	35.8	-0.184***	-27.6***	-9.0***	-16.2	-50.3	-40.2	-16.9
Maharashtra	MH	9.2	0.186	0.010	40.1	1.8	46.4	0.7	42.9	9.5	0.071	0.002	17.3	0.5	41.3	0.3	21.6	-0.115***	-22.9***	-5.1***	-21.3	-61.8	-57.0	-11.1
Manipur	MN	0.2	0.204	0.010	44.4	1.8	46.0	0.7	1.1	0.2	0.085	0.003	21.0	0.7	40.3	0.3	0.5	-0.120***	-23.4***	-5.7***	-0.6	-58.5	-52.6	-12.4
Meghalaya	ML	0.3	0.340	0.024	61.4	3.7	55.4	1.1	1.9	0.3	0.146	0.006	32.8	1.3	44.5	0.4	1.3	-0.194***	-28.6***	-10.9***	-0.5	-57.1	-46.6	-19.7
Mizoram	MZ	0.1	0.139	0.012	30.8	2.3	45.1	1.2	0.3	0.1	0.044	0.003	9.8	0.7	45.2	0.7	0.1	-0.095***	-21.0***	0.1***	-0.2	-68.2	-68.3	0.3
Nagaland	NL	0.1	0.295	0.012	57.0	1.8	51.7	0.8	1.0	0.1	0.099	0.004	23.7	0.8	41.7	0.4	0.4	-0.196***	-33.3***	-9.9***	-0.6	-66.4	-58.4	-19.2
Odisha	OR	3.6	0.336	0.014	64.2	2.1	52.3	0.9	27.1	3.4	0.156	0.003	35.9	0.5	43.4	0.2	16.4	-0.180***	-28.3***	-9.0***	-10.7	-53.7	-44.1	-17.1
Punjab*	PB	2.5	0.108	0.008	24.0	1.6	45.0	0.7	6.9	2.3	0.025	0.001	6.1	0.3	41.3	0.4	1.8	-0.083***	-18.0***	-3.7***	-5.1	-76.9	-74.8	-8.3
Rajasthan	RJ	6.0	0.332	0.015	62.2	2.0	53.4	1.0	43.2	5.6	0.145	0.003	32.0	0.5	45.3	0.2	23.7	-0.187***	-30.2***	-8.1***	-19.6	-56.4	-48.6	-15.2
Sikkim	SK	0.1	0.177	0.015	37.5	2.9	47.3	0.8	0.3	0.0	0.019	0.002	4.9	0.4	38.1	0.5	0.0	-0.159***	-32.6***	-9.2***	-0.2	-89.5	-87.0	-19.4
Tamil Nadu	TN	5.5	0.157	0.008	37.4	1.7	41.9	0.3	24.0	6.7	0.027	0.001	7.3	0.3	37.5	0.3	6.5	-0.129***	-30.1***	-4.4***	-17.5	-82.5	-80.5	-10.5
Tripura	TR	0.3	0.265	0.017	54.6	2.7	48.6	1.0	2.2	0.3	0.087	0.005	20.3	0.9	42.7	0.6	0.8	-0.179***	-34.3***	-6.0***	-1.4	-67.4	-62.8	-12.3
Uttar Pradesh	UP	16.4	0.361	0.007	68.8	1.1	52.5	0.4	131.3	15.8	0.183	0.002	40.8	0.3	44.7	0.1	85.2	-0.179***	-28.0***	-7.7***	-46.2	-49.4	-40.7	-14.7
Uttarakhand	UT	0.8	0.182	0.013	39.3	2.7	46.3	0.7	3.6	0.8	0.072	0.003	17.3	0.7	41.8	0.4	1.9	-0.110***	-22.1***	-4.5***	-1.7	-60.4	-56.1	-9.8
West Bengal	WB	8.0	0.302	0.010	58.0	1.6	52.1	0.6	53.6	7.6	0.110	0.003	26.3	0.7	41.9	0.2	26.3	-0.192***	-31.7***	-10.1***	-27.3	-63.5	-54.7	-19.5
<i>Age groups</i>																								
Children (0-17)		40.2	0.338	0.003	63.0	0.4	53.7	0.2	294.8	34.2	0.159	0.001	35.0	0.2	45.5	0.1	158.3	-0.179***	-28.1***	-8.1***	-136.5	-52.9	-44.5	-15.1
Adults (18+)		59.7	0.246	0.002	49.8	0.4	49.4	0.2	345.7	65.8	0.104	0.001	24.2	0.1	42.8	0.0	211.2	-0.142***	-25.6***	-6.6***	-134.5	-57.8	-51.3	-13.4
0-9		22.6	0.376	0.003	68.7	0.4	54.8	0.2	180.3	18.3	0.193	0.001	41.6	0.2	46.3	0.1	100.8	-0.183***	-27.1***	-8.4***	-79.5	-48.7	-39.4	-15.4
10-17		17.7	0.290	0.003	55.8	0.5	51.9	0.2	114.5	15.9	0.121	0.001	27.3	0.2	44.2	0.1	57.5	-0.169***	-28.5***	-7.7***	-57.0	-58.3	-51.0	-14.9
18-59		51.2	0.246	0.003	49.3	0.4	49.8	0.2	293.6	55.4	0.102	0.001	23.8	0.1	43.0	0.1	174.9	-0.143***	-25.5***	-6.7***	-118.7	-58.3	-51.7	-13.6
60+		8.6	0.247	0.003	52.5	0.5	47.0	0.2	52.2	10.4	0.110	0.001	26.5	0.2	41.5	0.1	36.4	-0.137***	-26.1***	-5.6***	-15.8	-55.6	-49.6	-11.8
<i>Castes</i>																								
Scheduled Caste		19.1	0.341	0.005	65.4	0.8	52.1	0.3	145.2	20.7	0.147	0.001	33.3	0.3	44.1	0.1	91.2	-0.194***	-32.1***	-8.0***	-53.9	-56.9	-49.1	-15.4
Scheduled Tribe		8.6	0.452	0.008	80.1	0.9	56.4	0.5	79.6	9.4	0.232	0.002	50.6	0.4	45.9	0.2	63.1	-0.220***	-29.5***	-10.5***	-16.6	-48.6	-36.8	-18.7
Other Backward Classes		40.3	0.293	0.004	58.2	0.6	50.4	0.3	272.4	43.0	0.118	0.001	27.2	0.2	43.5	0.1	155.1	-0.175***	-31.0***	-6.9***	-117.3	-59.6	-53.2	-13.7
Other		29.0	0.179	0.005	36.6	0.9	49.1	0.5	123.3	22.5	0.066	0.001	15.6	0.2	42.6	0.2	46.5	-0.113***	-20.9***	-6.5***	-76.8	-63.0	-57.3	-13.3
<i>Religion</i>																								
Hindu		80.4	0.281	0.003	55.4	0.5	50.7	0.2	517.6	80.2	0.122	0.001	28.1	0.1	43.5	0.1	298.7	-0.158***	-27.3***	-7.2***	-219.0	-56.4	-49.2	-14.2
Muslim		14.0	0.336	0.010	60.8	1.5	55.2	0.5	99.0	14.1	0.146	0.002	31.4	0.5	46.5	0.2	58.8	-0.190***	-29.4***	-8.7***	-40.2	-56.5	-48.3	-15.8
Christian		2.3	0.193	0.012	39.3	2.0																		

assets: telephone, radio, television, computer, refrigerator, bicycle, motorcycle, or animal cart (and did not have a car/truck), in 2015/16 only 14.0 percent did not own more than one of these assets.

Put differently, if we consider how deprivations declined *relative* to their starting levels, we find that 18–70 percent of deprivations in the ten indicators that were present in 2005/6 had been eradicated by 2015/16 (Table C.2, Appendix C). Relative to the starting rates of deprivation, the largest share of societal deprivations (70 percent) were removed for assets and school attendance, and electricity (63 percent). This was followed by strong gains for years of schooling (45 percent), child mortality (44 percent), and nutrition (34 percent). The smallest decrease in levels of deprivation was observed for the housing indicator (18 percent).

### 3.1.2. Reduction of deprivations that affect the poor

Recall that the MPI identifies as poor people who are deprived in at least one-third of the weighted indicators. So how did deprivation in indicator change among the poor? This question is important because each reduction of a poor person's deprivation will directly change the MPI. To answer this requires an analysis of the joint distribution of indicators. To be more precise, we are wondering: did most of the reductions of deprivations occur among people who were deprived in at least one-third of weighted indicators at the same time? Or did most occur among people who face only a few deprivations or who are marginally poor? The censored headcount ratios provide the percentage of the population who are MPI poor and are deprived in each indicator. Figure 2 shows the absolute change in censored headcount ratios using the same axes as Figure 1.

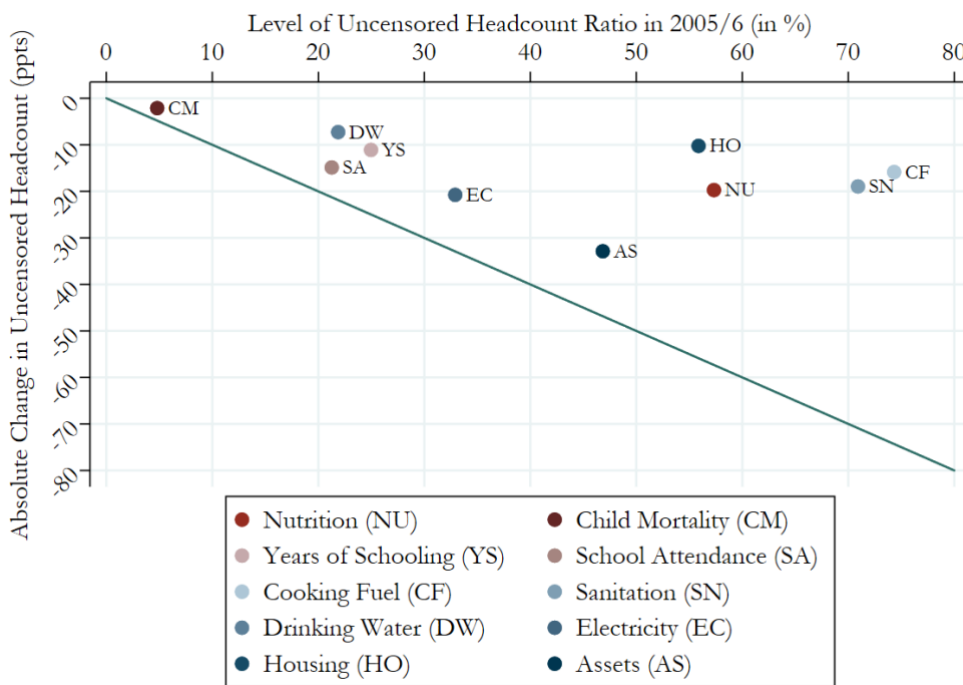
Each of the ten indicators was reduced, and their reduction was statistically significant at the one percent level. As can be seen visually, the highest improvements in terms of percentage points are found in nutrition, cooking fuel, sanitation, and assets. Housing and electricity also had large reductions affecting more than one in five people in India.

As Figure 2 shows, India's progress in reducing multidimensional poverty can be attributed to all ten indicators.<sup>14</sup> While the y-axis shows the absolute change in each censored headcount ratio, the 45-degree line indicates the change required for a 100 percent reduction in that indicator. Therefore, the gap between each indicator-bubble and the 45-degree line indicates the amount needed to reduce the deprivation entirely. It thus gives insight into the relative reduction of each indicator as well. The closer the bubble is to the line, the higher is the relative reduction. We see, for example, that despite the low absolute change in child mortality, its relative reduction has been huge. All censored headcount ratios

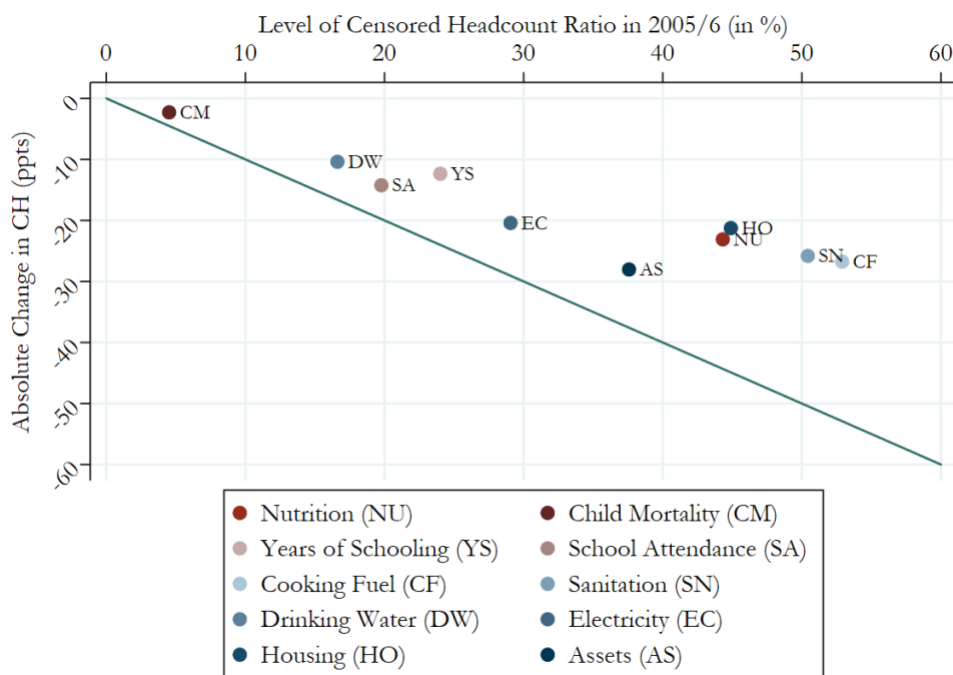
<sup>14</sup> Numbers related to Figure 2 are presented in Table C.3, Appendix C.

decreased by at least 50 percent except for housing (48 percent) and in some cases (electricity, assets) dropped by more than 70 percent.

**Figure 1 Change in uncensored poverty headcount ratios of 10 indicators**



**Figure 2 Change in censored headcount (CH) ratios of 10 indicators**



Malnutrition tends to be high in India. While this is still the case comparatively speaking, the censored headcount ratio of nutrition more than halved. In 2005/6, 44.3 percent of India's population was multidimensionally poor and had at least one malnourished child or adult within the household, while in 2015/16 this proportion has reduced to 21.2 percent. Furthermore, in the space of health, the censored headcount ratio of child mortality fell from 4.5 percent in 2005/6 to 2.2 percent ten years later. Improvements in education were clearly visible: the censored headcount ratios for years of schooling and school attendance more than halved.

Similarly, living standards have improved in every indicator. Between 2005/6 and 2015/16, the incidence of people being multidimensionally poor and deprived in housing conditions decreased from 44.9 percent to 23.6 percent. The reduction of deprivations in drinking water fell from 16.6 percent to 6.2 percent, and the percentage of people using solid cooking fuel reduced by half (52.9 percent to 26.2 percent). Censored headcount ratios in electricity and asset ownership reduced more than 70 percent.

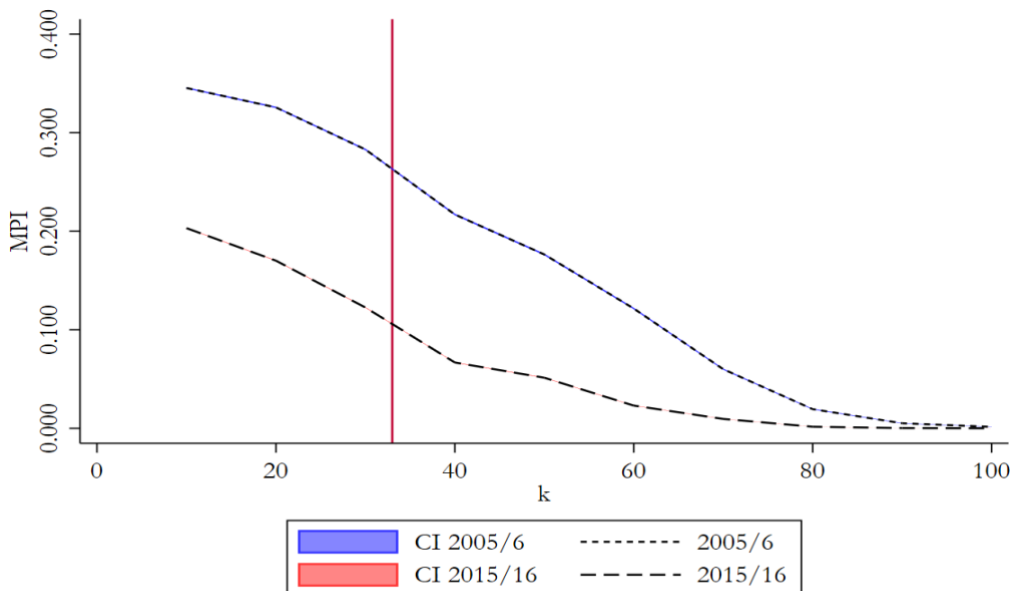
If we compare the percentage point changes in the uncensored (Figure 1; Table C.1, Appendix) vs censored headcount (Figure 2; Table C.3, Appendix) ratios we find that the percentage changes are quite similar for years of schooling, school attendance, child mortality and electricity, meaning that nearly all of the reductions in deprivations occurred among persons who were MPI poor. For nutrition the reduction of censored headcount ratios (Table C.3, Appendix) was 3.4 percentage points more than the population level reductions (Table C.1, Appendix). This means that 19.7 percentage points of the reduction in nutrition deprivations really occurred as shown in Table C.1, Appendix. However, among the poor effectively 3.4 percent of the population appear to have graduated to non-poor status, while still being deprived in nutrition. In the case of drinking water, there is a 3.1 percentage point difference (Table C.3, Appendix).

For three indicators, the differences are larger: for sanitation it is 6.9 percent, cooking fuel it is 10.9 percent and for housing, the difference is 11.0 percent. In the case of these indicators, while most of the reduction did appear to occur among the poor, a reduction in the density or share of overlapping deprivations also occurred. Effectively, many graduated from poverty to a state of vulnerability. Assets, on the other hand, had higher reductions in the overall population than among the poor. So effectively it could be imagined that 27.9 percent of poor people became non-deprived in assets and furthermore, 4.8 percent of the population who were not poor, reduced their deprivation in assets (Table C.3, Appendix).

Naturally, using repeated cross-section data it is impossible to track these transitions precisely. The interpretation of India's changes suggests that the reduction of poverty was powerfully driven by the reduction of deprivations among persons who were poor. In some cases, however, particularly with

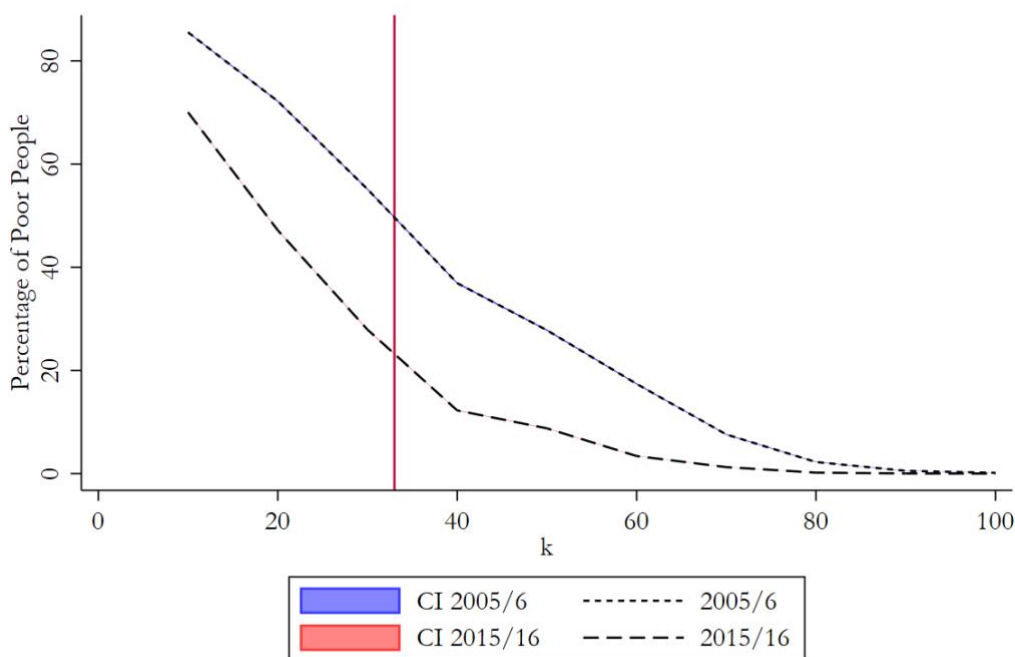
regards to cooking fuel and sanitation, reductions in a different indicator meant people graduated out of poverty, but retained their deprivation in those indicators, whose uncensored headcount ratios considerably exceeds the incidence of MPI.

**Figure 3 MPI over alternative poverty cut-offs (k)**



Based on authors' calculations with NFHS-3 and NFHS-4 data.  
95% Confidence Intervals are so small that they overlay the point estimates.

**Figure 4 Headcount ratio (H) over alternative poverty cut-offs (k)**



Based on authors' calculations with NFHS-3 and NFHS-4 data.  
95% Confidence Intervals are so small that they overlay the point estimates.

This section has demonstrated how unpacking the change in MPI into the changes in its component indicators – a process which is not possible for the headcount ratio – greatly illuminates the story of ‘how’ poverty decreased. But are these findings restricted to the chosen poverty cutoff of one-third?

### 3.1.3. Poverty reduction between 2005/6 – 2015/16 across alternative poverty cutoffs

Figures 3 and 4 plot the MPI and H respectively over all values of the poverty cutoff  $k$  for each year. There are large and statistically significant reductions in multidimensional poverty in India between 2006/6 and 2015/16 for all poverty cutoffs. In order to explore how poor people’s deprivation profiles changed, indicator by indicator as well as overall, it is necessary to fix a poverty cutoff, so we return to using the poverty cutoff of one-third. The next section demonstrates the value-added of using the MPI rather than the poverty rate to capture the pro-poorness of poverty reduction trends by groups.

## 3.2. Poverty changes by states: Fastest movers and what changed most

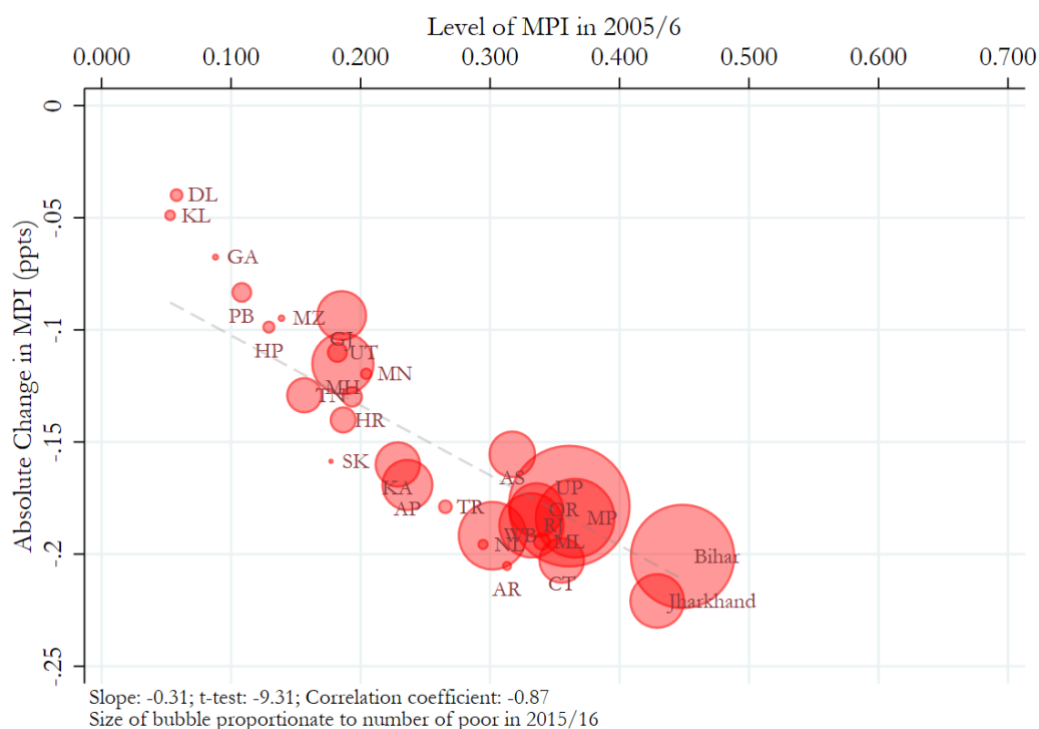
The MPI is disaggregated into 29 States and Union Territories. It is noteworthy that each of these had statistically significant reductions in MPI, H, and A at the 1 percent level (Table 1). One factor that is of particular interest to pro-poor patterns of poverty reduction that leaves no one behind is the rate of poverty reduction among the poorest groups. Earlier work by Alkire and Seth (2015) found that progress in terms of the MPI headcount ratio as well as the MPI itself had been slower for the poorer states, castes and religious groups. In stark contrast, we find here that seven of the ten states that had the fastest reduction of MPI were among the 10 poorest states in India. Jharkhand, which was second poorest in 2005/6, had the fastest reduction of all states, followed by Arunachal Pradesh, Chhattisgarh, Bihar, Nagaland, Meghalaya, West Bengal, Rajasthan, Madhya Pradesh, and Odisha (Table 1). Figure 4a illustrates this pattern.

In Figure 5, state-level absolute changes in MPI (y-axis) are plotted over MPI levels of 2005/6 (x-axis). The poorest state in 2005/6 – Bihar – had the fourth fastest reduction in MPI. Nagaland, West Bengal, and Tripura were not among the poorest 10 states, yet had rapid reductions in mPI. Assam had considerably slower progress in MPI reduction compared with other states having similar or greater levels of poverty, although it was still the sixteenth fastest. The correlation between MPI starting level and absolute change is statistically significant and the slope of the simple linear least squares regression line, which shows the fit between the change and the starting level of MPI, weighted by the number of poor in 2015/16, shows a fast change in MPI.

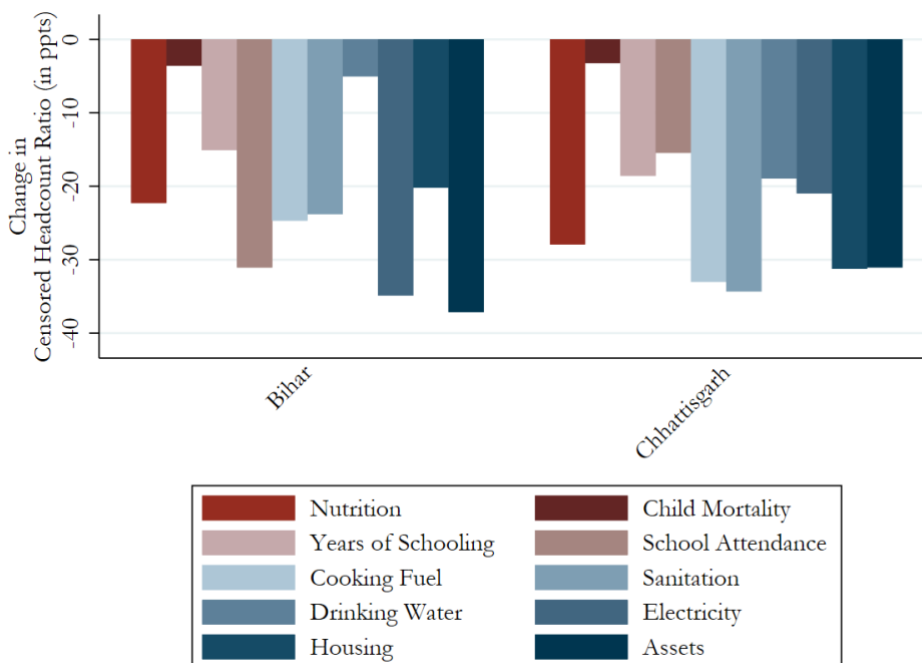
In terms of relative change, some of the least poor states improved MPI the most. This is not uncommon because a relative measure shows what percentage of the distance to zero poverty was covered, and least poor states do not have as far to go. Kerala, for example, reduced its MPI by around 92.4 percent from



**Figure 5 Changes in MPI across Indian States between 2005/6 and 2015/16**



**Figure 6 Bihar and Chhattisgarh: Change in the proportion of people who are multidimensionally poor and deprived in a given indicator between 2005/6 and 2015/16**



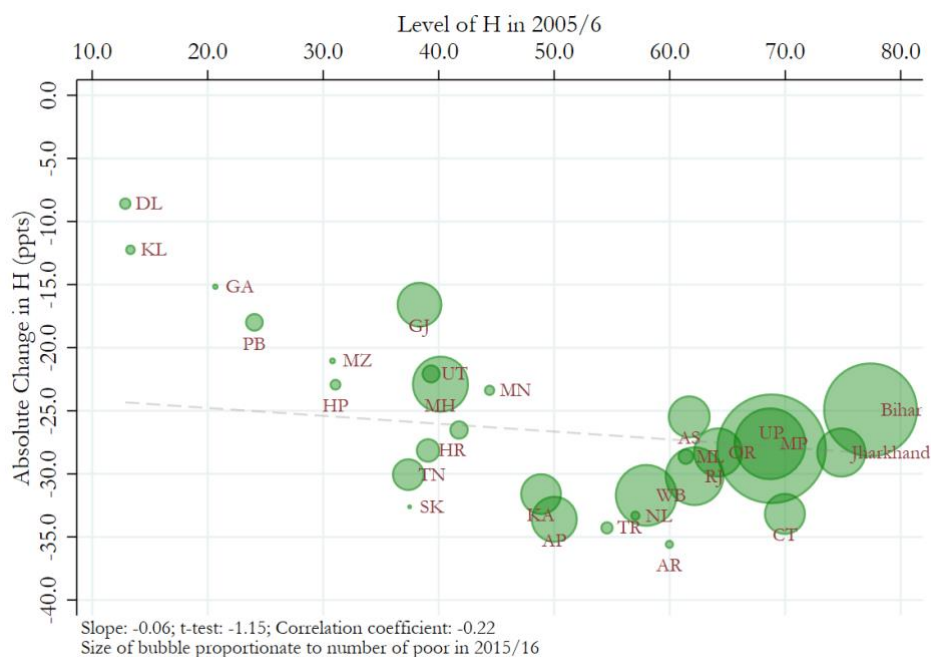
a starting headcount ratio of 13.3 to 1.1 percent in 2015/16 (Table 1). Similarly, Sikkim reduced the MPI by a massive 89.5 percent that lowered the MPI from 0.177 to 0.019, while the headcount ratio fell from 37.5 percent to 4.9 percent (Table 1). It is also encouraging that eight of the poorest ten states cut their

starting level of MPI by more than 51 percent: Nagaland, Arunachal Pradesh, West Bengal, Chhattisgarh, Meghalaya, Rajasthan, Odisha and Jharkhand. State patterns of MPI and of its reduction by indicator were often similar but there were some interesting variations (Table C.3, Appendix C). Chhattisgarh and Bihar, for example, were among the ten poorest states and the magnitude of reduction in asset deprivations are similar. But Chhattisgarh had larger reductions in housing, sanitation, cooking fuel, years of schooling, and nutrition; Bihar had larger reductions in electricity and school attendance (see Figure 6). In absolute terms, people who were poor and deprived in electricity were negligible by 2015/16 in Chhattisgarh, whereas water deprivations were small in Bihar (Table C.3, Appendix C).

Is this same result visible if, instead of the MPI, we consider H? Actually, the picture is dramatically different (Table 1). Figure 7 plots the absolute changes in headcount ratio (H) on the vertical axis, and the initial 2005/6 levels of H at the state level horizontally. The relationship has a v-shaped pattern, with the fastest reduction in the mid-poverty states such as Andhra Pradesh, West Bengal and some for the North Eastern states, although Chhattisgarh also fares very well. However, Bihar, Jharkhand, Uttar Pradesh and Madhya Pradesh are slower in absolute terms. The correlation between starting level and absolute change in H is minimal and not statistically significant, with the slope almost horizontal. Why are these two pictures of changes in MPI and H so different? And which is correct? To solve this dilemma, we study the trends in the intensity of poverty (A) – the overlapping deprivations among the poor (Figure 8) which is the second component of the MPI alongside H.

Figure 8 provides the essential clue. With few exceptions, the reduction in intensity was considerably fastest among the poorest. The correlation is statistically significant, with the correlation coefficient quite high (near -1) and slope quite steep. Jharkhand clearly leads all states in India in reducing the intensity of the still-poor persons, followed by Bihar and Meghalaya then West Bengal. Thus, what the trends in headcount ratio overlook are the positive pro-poor gains among poor persons who remain poor but now suffer a lighter load of overlapping deprivations, as reflected in their lower intensity. For example, in Jharkhand, each poor person's deprivation score on average reduced by 12.6 percentage points, which is equivalent to at least two fewer living standard deprivations in 2015/16 as compared to 2005/6. Recall that the MPI is reduced if any deprivation of any poor person is removed. And there are exactly two possible effects of removing deprived deprivations of poor persons: a) the headcount ratio goes down (because that person leaves poverty) or b) intensity goes down (because that persons' deprivation score reduces). The India 2005/6 to 2015/16 trends clearly show that both paths were taken. So tracking only the headcount ratio would miss out a large part of the story – one that, in this case, benefitted the poorest.

**Figure 7 Changes in headcount ratio (H) across Indian States between 2005/6 and 2015/16**



**Figure 8 Changes in average intensity (A) across Indian States between 2005/6 and 2015/16**



For that reason, we propose assessing the ‘leave no one behind’ consideration using MPI, which makes visible reductions in every deprivation of every poor person, and not only a partial index such as H or A.

### 3.3. Disaggregation by population subgroups

Is the pro-poor pattern of reduction of MPI across states mirrored in other groups? The following sub-sections present the progress made of each of the subgroups of urban-rural areas, caste, religion and age groups. We find strong pro-poor trends among all subgroups over time by levels of MPI, H and A (Table 1).

A classic question, given the patterns of rural-urban migration, is how patterns of poverty reduction vary across these areas. The NFHS surveys use the national census definitions to identify rural and urban clusters, and are designed to be representative of each area (IIPS and ICF 2017 p 1). Before executing the survey, the household listings are updated to reflect major population shifts. Despite population shifts the data in Table 1 seem to show a convergence in absolute terms due to larger absolute reductions in rural poverty, which was considerably higher and affected two-thirds of the population. In both rural and urban areas, the MPI was halved. In absolute terms, rural poverty decreased far faster than urban, whereas in relative terms, urban poverty went down slightly faster. The intensity of multidimensional poverty reduced more in rural than in urban areas. Rural poverty halved in terms of MPI but not headcount ratio, although the latter (H) went down from 68.1 percent to 36.8 percent. The urban headcount ratio also more than halved from 25.0 to 9.2 percent. Urban MPI too more than halved, plummeting from 0.117 to 0.039.

In the NFHS surveys, the many caste groups are grouped into four major categories: Scheduled Castes (SC), Scheduled Tribes (ST), Other Backward Classes (OBC), and Other.<sup>15</sup> While SC include Dalit communities, the category ‘Other’ include higher castes. The SC and ST communities have tended to be the most disadvantaged subgroups in India. In 2015/16, this is still the case. Half of the people belonging to ST communities are multidimensionally poor (Table 1). They were also the poorest in 2005/6 with a headcount ratio of 80 percent. Nevertheless, their progress was impressive and their overall MPI had the largest absolute reduction of the caste groups, from 0.452 to 0.232. The SC communities had strong if slightly slower MPI reduction in absolute terms. In terms of the headcount ratio (which as we have seen overlooks reductions among the poor), the SCs more than halved their MPI in relative terms and also reduced H by a larger magnitude: 32.1 percentage points. The two groups of OBC and Other also halved their MPI in this period. But in absolute terms SC and ST communities account for the highest reduction

<sup>15</sup> The caste designation of the household head is applied to all members of the household, which means it is not possible to identify mixed-caste households, nor to ascertain whether their prevalence is increasing. Also, caste is self-identified, and a potential non-sampling error is that in different NFHS rounds persons may have different incentives to self-report different caste identities due to reigning political or cultural contexts (IIPS and ICF 2017 p 1). Some 0.72% of the sample in NFHS 4 and 0.41% in NFHS 3 reported they “do not know” their caste category. We do not present the analysis of this particular category in this section.

of poverty - a scenario that is opposite to the findings of Alkire and Seth (2015) for the period of 1998/99 to 2005/6. During that period India's poorest caste groups witnessed the slowest progress according to both MPI and H.

The pro-poor poverty reduction is also prevalent when we look at absolute changes across religious groups (Table 1). Religion is self-identified, and is a variable commonly used for disaggregation in the NFHS-4 survey report (IIPS and ICF 2017).<sup>16</sup> A positive observation from religious disaggregation is that all religious groups considered halved their MPI, and that the results were pro-poorest. To elaborate, Muslims were the poorest religious group of 2005/6 with an MPI of 0.336 and H of 60.8 percent, followed by Hindu (MPI 0.281, H 55.4 percent) and Christian (MPI 0.193, H 39.3 percent). In absolute terms, both the MPI and H reduced faster for Muslims than for other religious groups, as the MPI dropped to 0.146 and H to 31.4 percent. Despite the huge progress, in 2015/16, Muslims are still the poorest religious subgroup with almost every third Muslim multidimensionally poor, compared to every sixth Christian.

We disaggregate the MPI by four age groups: children between 0 and 9 years, 10 and 17 years, adults between 18 to 60 years, and above 60 years (Table 1). We also present the results for two broad groupings: children (defined as under 18) and adults (18 years and older).<sup>17</sup> In 2005/6, children aged 0 to 9 and 10 to 17 had significantly higher levels of MPI and H. While this is still the case in 2015/16, in terms of absolute reductions of the MPI, both groups of children saw higher reductions (0.183 and 0.169, respectively) than the adult age groups. Similarly, the headcount ratios (H) for both have changed faster than for the two adult age groups in absolute terms. The poorest age group of 2005/06 (0-9 years) saw its headcount ratio decline by 27.1 percentage points, while the H for the second poorest (10-17 years) declined by 28.5 percentage points, both outpacing the older subgroups. The MPI was halved for all age groups except for children aged 0-9. In terms of the number of poor, more than half of the 271 million people to leave poverty were children. In summary, strong and consistent reductions are evident across all age groups with the highest reductions for children, and children aged 0 to 9 years are the poorest age group in 2015/16.

<sup>16</sup> The religious designation of the household head is applied to all members of the household, which means it is not possible to identify mixed-religious households, nor how their prevalence is changing over time.

<sup>17</sup> Age disaggregation of any household poverty measure such as the global MPI or a monetary poverty measure must be carefully interpreted (UNICEF and World Bank Group 2016). The unit of identification is the household, and so a child is identified as poor based on the combined deprivation profile of all household members.

### 3.4. Distributional shift favoring the most deprived

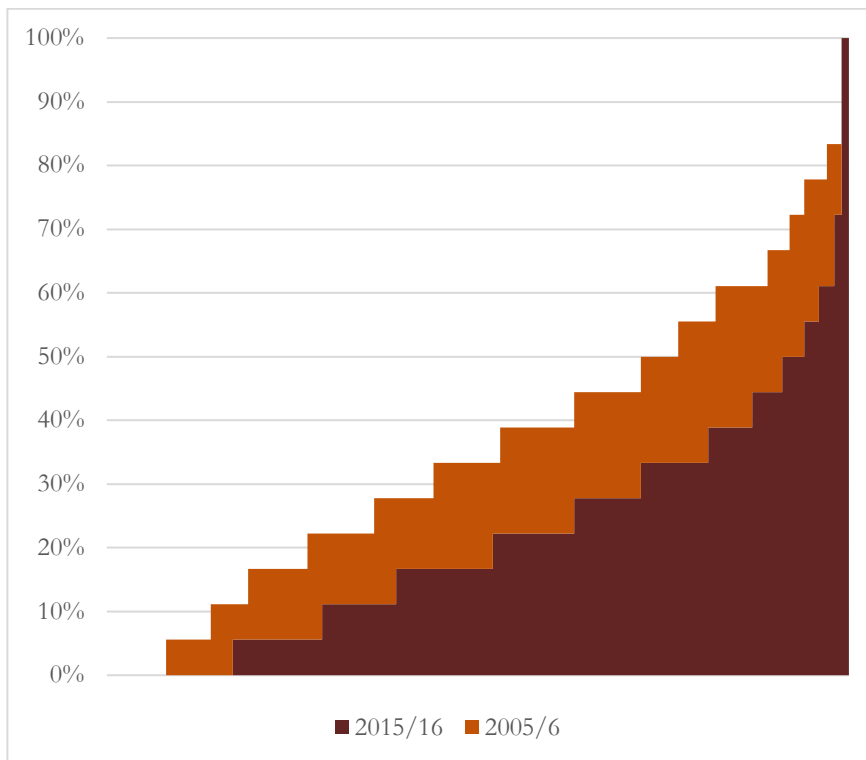
The consistent pro-poor trends across all possible poverty cutoffs, and across differently-defined population subgroups suggests there may have been a societal-wide shift in deprivation scores experienced by people in India across the two periods. How might we assess that more precisely? And are results for both the MPI and H stable across different poverty cutoffs?

Figure 9 depicts the entire distribution of deprivation scores in each year – irrespective of any poverty cutoff. Similar to what is often shown to illustrate income distributions, we plot a quantile function (intuitively known as Pen's Parade (Pen 1971)) for the distribution of deprivation scores or counting vectors (c-vectors), which are ordered by the value of the deprivation score. The least poor percentile i.e. those experiencing the lowest deprivation score (which is zero), are on the left. The most deprived percentile can be found on the right of the x-axis. The number of bars with the same height show the percentage of people who experience that deprivation score. The light shaded bars show the deprivation scores by percentile for 2005/6; the darker ones are for 2015/16. As is clearly visible, all percentiles have a lower deprivation score in the 2015/16 distribution except the 100<sup>th</sup>, which is equal. For example, the poorest percentile in 2005/6 experienced deprivation scores of more than 80 percent of the weighted deprivations, whereas in 2015/16 this has reduced to around 70 percent. The shift is even larger for lower percentiles, such as the 60<sup>th</sup>, where the deprivation score reduced from around 45% to 28%.

Recall that earlier work (Alkire and Foster 2011, Lasso de la Vega 2010, building upon Foster and Shorrocks 1988 and Atkinson 1987), established dominance results for the poverty cutoff  $k$  given the vector of weights and deprivation cutoffs. Consider the unidimensional distribution of attainment scores, where each attainment score takes the value of one minus the deprivation score. The cumulative distribution function (CDF) of the attainment score distribution is used to establish first order dominance.<sup>18</sup> In Figure 10, the CDF shows poverty dominance of the attainment scores across the decade. First order dominance of the CDF implies that the headcount ratio (H) in 2015/16 is never greater than that of 2005/6 and is lower for at least one  $k$  value. In the case of MPI, poverty dominance of the CDF implies similarly that the MPI in 2015/16 is never greater than in 2005/6 and is lower for at least one  $k$  value. Thus it is established that this specification of multidimensional poverty, whether measured by MPI or the headcount ratio, has decreased in India regardless of the poverty cutoff applied.

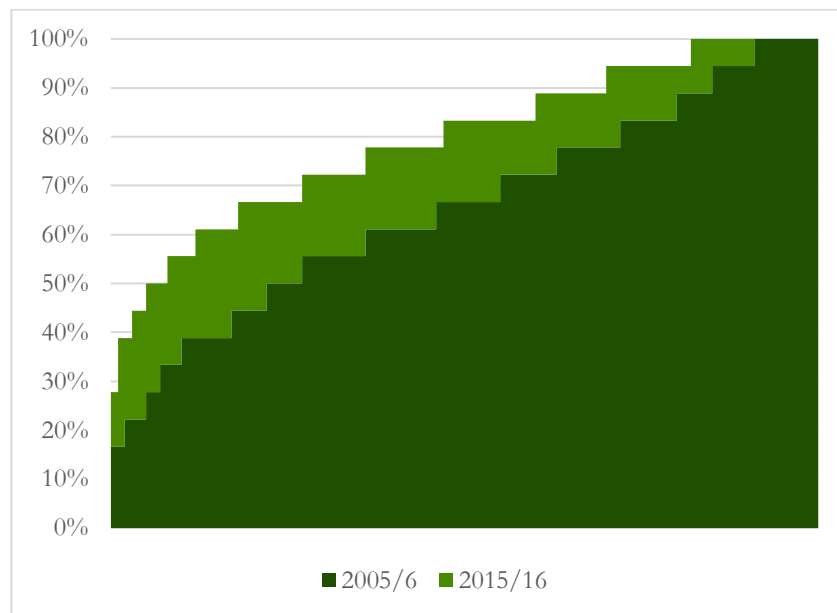
<sup>18</sup> The CDF is the inverse of the quantile function depicted in Figure 9. For first order dominance the deprivation and attainment score cases coincide. We follow Alkire and Foster (2011) in using attainment scores; Lasso de la Vega (2010) equivalently uses deprivation scores.

**Figure 9** Quantile function of deprivation scores by percentile of the population, 2005/6 - 2015/16



From left to right: least deprived percentile to most deprived percentile.

**Figure 10** Cumulative distribution function of the attainment scores by percentile 2005/6 - 2015/16

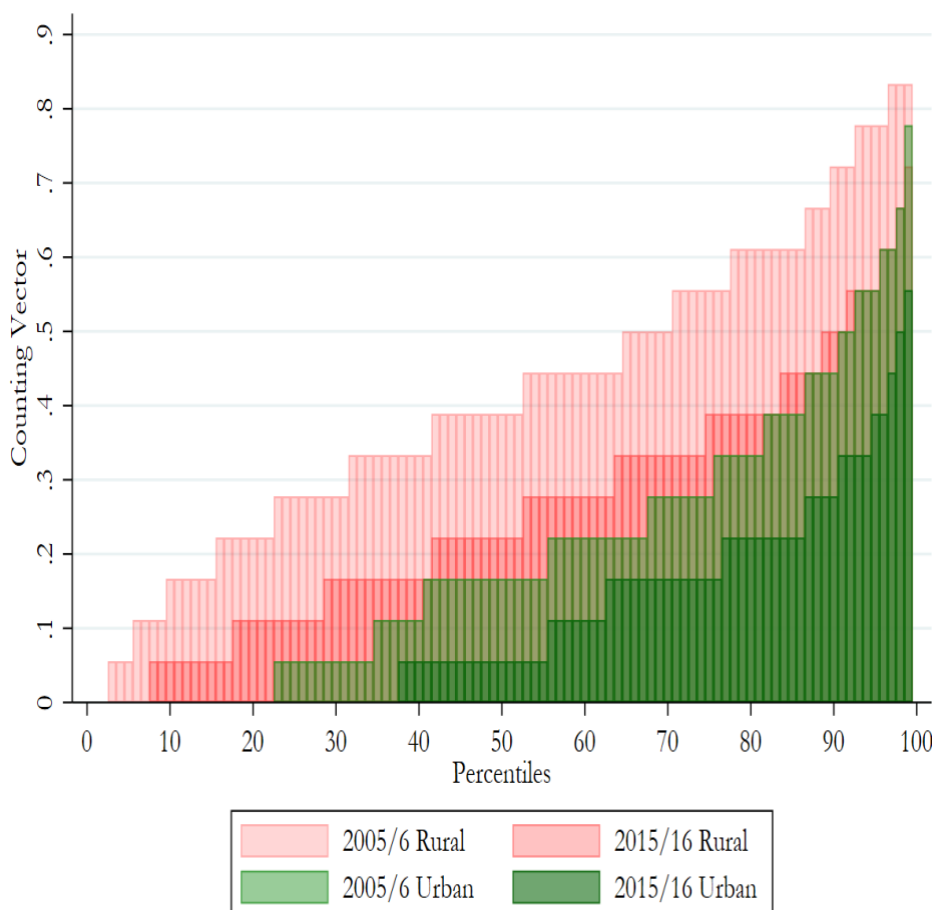


Horizontal axis: attainment score; vertical axis: percentiles of the population. Left to right from lowest to highest attainment scores for each percentile.

In addition to using indicator-level details to understand poverty reduction trajectories, and distributional information to establish dominance results, we can use quantile functions to compare distribution-wide reductions of deprivation scores for population subgroups. For example, Figure 11 shows the

distributional shift across India's rural and urban areas. It is obvious that rural India has by 2015/16 moved closer to 2005/6 levels of urban India. While the gap between the two areas has reduced over the decade, the clear divide between rural and urban India has remained. Overall, there is a clear shift towards fewer deprivations over time.

**Figure 11** Quantile Function of counting vector by rural and urban areas for 2005/6 and 2015/16



From left to right: least deprived percentile to most deprived percentile.

The poverty dominance of the attainment CDFs is an important new observation, and was not explored in earlier tests of robustness, which focused on pairwise comparisons or rank correlations of country or subnational rankings. As a more general result, it firmly establishes a set of important relationships between both MPI and H for the two years.

#### 4. Robustness of the number of poor leaving poverty

Thus far we have focused on demonstrating the value-added of the adjusted headcount ratio MPI in analysing the composition and the pro-poorness of poverty reduction, and also the feasibility of jointly assessing the stability of these findings by exploring poverty dominance. However, the headcount ratio has two features that the MPI overlooks. One is its mere familiarity, but the other is that the headcount



ratio multiplied by the population provides the number of poor people. This is a vital piece of information, both because it locates poverty reduction across a number of peoples lives, and because this information, which includes population changes and growth, is used for policies such as resource allocation. The last portion of this paper thus focuses on assessing the robustness of the number of poor people – a statistic drawn from the headcount ratio – using a rigorous albeit data intensive technique.

In 2018, five of the ten original global MPI indicators were adjusted to better align to the SDGs (Alkire and Kanagaratnam, 2020; Alkire and Jahan, 2018; OPHI 2018). A question naturally arises whether observation that some 271 million fewer people are MPI poor in 2015/16 than 2005/6 is sensitive to this revision. If the original MPI 2010 specifications were used, or if alternate indicator specifications were used, how would this have affected the number? To scrutinise that question we ran the original 2010 MPI specifications (labelled as Trial 0) and 19 additional alternative MPIs (labelled as Trial 1-19) using the NFHS 2005/6 and 2015/16 datasets, to assess how results are affected (Table D.1, Appendix D). That is, while in the dominance assessment we held the indicators and deprivation cutoffs constant, in this section, we systematically explore alternative definitions of child nutrition, child mortality, years of schooling, housing, and assets.

As reported in Appendix D, if the 2010 MPI specifications were used (Trial 0), then we would have found that 286 million fewer people were MPI poor in 2015/16. Across the other 19 specifications in all but one, the number of poor people who left poverty was higher than 271 million, in the range of 275 million to 302 million. Only in one extreme trial (Trial 18) in which only child malnutrition data were retained and no adult malnutrition data was included did the number exiting poverty drop below 271 million.

Does the year of population affect this result? It should be noted that 92 percent of the interviews in the NFHS 2005/6 were conducted in 2006. In NFHS 2015/16, we find that close to two-third (62%) of the interviews were conducted in 2015. This motivated us to use the 2006 and 2016 population estimates to compute the total number of MPI poor in India. As such, the figure of close to 271 million people exiting poverty is based on the population estimates between 2006 and 2016.<sup>19</sup> Naturally a question arises whether this figure would have changed had we used population data from 2015 instead of 2016 for the latter period. Indeed, if we had used the 2015 population estimates, the number of people moving out of

<sup>19</sup> We use the 2006 and 2016 population figures that were published in World Population Prospects: The 2017 Revision (United Nations, 2017). At the time of this publication, the World Population Prospects 2019 version has become available. This 2019 publication changed the population estimations of India retrospectively, which affects our estimation of the numbers. By the new population estimates for 2016, 273 million Indians moved out of poverty instead of 271 million based on the 2017 edition of World Population Prospects. We use population figures from the World Population Prospects 2017 instead of 2019 in this paper to be consistent with previously published work including UNDP-OPHI, 2019 and OPHI, 2018.

poverty would have increased by close to 4 million people for each trial MPI between 2006 and 2015. Thus we can say with rigour that the figure of close to 271 million represents a lower bound of the plausible numbers exiting poverty.

## 5. Concluding Remarks

This paper investigates the changes in multidimensional poverty 2005/6 to 2015/16 in India using data from the third and fourth rounds of the NFHS surveys. We find a very strong reduction, indeed a halving, of the MPI during that decade. Furthermore, subnational patterns of poverty reduction are strongly pro-poor, whereas from 1998/99 to 2005/6 they had been regressive. The findings also demonstrate the value-added of using MPI (which respects dimensional monotonicity) rather than just a headcount ratio to assess trends: the pro-poor change in MPI is driven by the reduction of intensity among the poor.

We observed, at the most general level, that whereas the MPI was more than halved 2005/06-2015/16 considering 95% confidence intervals, the headcount ratio did not quite fall by half. How do we interpret this finding?

First, when we explore it sub-nationally we find the same pattern holds by state, caste group and religion. In Figure 5, we observed that the poorest states of 2005/06 reduced poverty (MPI) the fastest, which implied a pattern of pro-poor poverty reduction. We concluded that states with higher MPI values in 2005/6 reduced poverty faster. However, when we considered the same graphic for the headcount ratio, the pattern is different (see Figure 7). In particular, the right end of the tail that depicts the poorest states and the biggest states that house most of the poor people, the pace of poverty reduction was slower. However, looking at the pattern of intensity reduction (see Figure 8), it is even more sharply evident among the poorest states. What this means is that in the poorest states a sizable reduction of intensity also drove changes. So in those cases where the persons remain poor, instead of being deprived in, for example, 77 percent of all weighted indicators now they are deprived only in 45 percent. They still are identified as poor, so the headcount ratio has not changed, but intensity – and correspondingly, their experience of interlinked deprivations – has.

Turning to the other groups, in absolute terms, the poorest always reduced MPI the fastest. In terms of caste divisions, the ST communities reduced MPI by -0.220 whereas the SC communities reduced it by -0.194. But the SC communities had a 32.1 percentage point decrease in their multidimensional poverty rate (H) whereas for ST it was 29.5 percentage points (see Table 1). Similarly, Muslims reduced their MPI by -0.190 which was faster than the reduction of Hindu by -0.158. But Muslims reduced their headcount ratio by 29.4 percentage points whereas Hindus were close, reducing by 27.3 percentage points. Interestingly, in the case of children, both measures align – considering either MPI or headcount ratio,

children 0-9 and 10-17 had a faster absolute reduction of poverty than the other age groups, making this a strongly significant finding. In relative terms, the less poor groups reduced MPI and H faster across these groups, as they had across states.

The pro-poor pattern for states, caste, and religious groups is generalised by observing the momentous shift across the entire distribution of deprivations, not just among the less poor strata. The quantile function of deprivation scores and the linked cumulative distribution function of attainment scores confirm that the two distributions exhibit poverty dominance.

One of the flaws of the poverty rate or headcount ratio in terms of measurement that led to the generation of improved poverty measures in the 1970s and 1980s by Amartya Sen (1979), Foster, Greer and Thorbecke (1984, 2010), and others was precisely its lack of monotonicity. The headcount ratio, being insensitive to the depth or breadth of poverty, does not provide any incentive to public actors to invest in reducing the disadvantages of the poorest, whose poverty status may not change. On the contrary, the poverty rate gives public actors an incentive to address the needs of the barely poor and so they come across the poverty line thus visibly reducing the headcount ratio, while the needs of the very poorest are left unaddressed. If such policies had driven change in multidimensional poverty 2005/6 to 2015/16, a monotonic decrease of the headcount ratio, but not of intensity or MPI, would be expected. Overall, this demonstrates the value-added of using MPI (which respects dimensional monotonicity) rather than just a headcount ratio to assess progress: the pro-poor change in MPI is driven by the reduction of intensity among the poor as well as by a reduction in incidence.

In the final section, recognising its policy salience, this paper scrutinized in depth the apparent finding that at the end of the decade under study, some 271 million fewer persons were living in multidimensional poverty, a magnitude of change rivalling the numbers exiting monetary poverty in China. That number of poor was assessed across an additional 19 trials of the MPI using different indicator definitions and combinations, and found to be robust.

In sum, the paper argues that the SDGs' focus solely on the multidimensional headcount ratio is mistaken, because that statistic is unable to verify two core priorities of the SDGs: leaving no one behind, and understanding interlinkages across indicators. The empirical application in India shows that a focus only on the headcount ratio – as impressive as that is – leaves out essential information regarding pro-poor reductions among the poorest places and subgroups. This pattern can only be established if trends in MPI, not poverty rate, are used as the measure of poverty. However, recognizing the ease of interpretation of the headcount ratio, and the policy salience of the number of poor, both will and should naturally continue to be reported alongside the MPI as part of the linked information platform. With that

in mind, robustness tests such as the one implemented with respect to the number of poor leaving poverty, should also be applied to these informative partial indices.

## References

- Alkire, S., Kanagaratnam, U., Nogales, R. and Suppa, N. (2020). 'Revising the global Multidimensional Poverty Index: Empirical insight and robustness', OPHI Research in Progress 56a, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S. and Kanagaratnam, U. (2020). Revisions of the Global Multidimensional Poverty Index: Indicator Options and Their Empirical Assessment. *Forthcoming in Oxford Development Studies*.
- Alkire, S., Kanagaratnam, U., Nogales, R., and Suppa, N. (2019). Sensitivity analyses in poverty measurement: The case of the global multidimensional poverty index. Paper prepared for the Special IARIW-World Bank Conference 'New Approaches to Defining and Measuring Poverty in a Growing World', Washington DC, November 7–8, 2019. <http://www.iariw.org/c2019washington.php>
- Alkire, S., Kovesdi, F., Mitchell, C., Pinilla-Roncancio, M. and Scharlin-Pettee, S. (2020). 'Changes over time in the global Multidimensional Poverty Index', OPHI MPI Methodological Note 50, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., Kanagaratnam, U. and Suppa, N. (2019). 'The global Multidimensional Poverty Index (MPI) 2019', OPHI MPI Methodological Note 47, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S. and Jahan, S. (2018). 'The new global MPI 2018: Aligning with the Sustainable Development Goals', OPHI Working Paper 121, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., Kanagaratnam, U. and Suppa, N. (2018). 'The global Multidimensional Poverty Index (MPI): 2018 revision', OPHI MPI Methodological Note 46, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., Oldiges, C. and Kanagaratnam, U. (2018). 'Multidimensional poverty reduction in India 2005/6–2015/16: Still a long way to go but the poorest are catching up', OPHI Research in Progress 54a, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., Jindra, C., Robles Aguilar, G. and Vaz, A. (2017). 'Multidimensional poverty reduction among countries in Sub-Saharan Africa', *Forum for Social Economics*, 46(2), pp. 178-191.
- Alkire, S., Roche, J. M. and Vaz, A. (2017). 'Changes over time in multidimensional poverty: Methodology and results for 34 countries', *World Development*, 94, pp. 232-249.
- Alkire, S. and Apablaza, M. (2016). 'Multidimensional poverty in Europe 2006–2012: Illustrating a methodology', OPHI Working Paper 74, Oxford Poverty and Human Development Initiative, University of Oxford.
- Alkire, S., Foster, J., Seth, S., Santos, M. E., Roche, J. M. and Ballon, P. (2015). *Multidimensional poverty measurement and analysis*. Oxford: Oxford University Press.
- Alkire, S. and Seth, S. (2015). 'Multidimensional poverty reduction in India between 1999 and 2006: Where and how?', *World Development*, 72, pp. 93-108.
- Alkire, S. and Santos, M. E. (2014). 'Measuring acute poverty in the developing world: Robustness and scope of the Multidimensional Poverty Index', *World Development*, 59, pp. 251-274.

- Alkire, S. and Foster, J. (2011). 'Counting and multidimensional poverty measurement', *Journal of Public Economics*, 95(7-8), pp. 476-487.
- Alkire, S. and Santos, M. E. (2010). 'Acute multidimensional poverty: A new index for developing countries', *OPHI Working Paper 38*, Oxford Poverty and Human Development Initiative, University of Oxford. Also in *Human Development Research Paper 2010/11*, UNDP.
- Atkinson, A. B. (2019). *Measuring poverty around the world*. New Jersey: Princeton University Press.
- Atkinson, A. B., (1987). 'On the Measurement of Poverty', *Econometrica*, 55, pp. 749-764.
- Chakravarty, S. R. and D'Ambrosio, C. (2006). 'The Measurement of Social Exclusion', *Review of Income and Wealth*, 52(3), pp. 377-398.
- Chen, S. and Ravallion, M. (2010). 'The developing world is poorer than we thought, but no less successful in the fight against poverty', *The Quarterly Journal of Economics*, 125(4), pp. 1577-1625.
- Coffey, D. and Spears, D. (2018). 'Open defecation in rural India, 2015–2016: Levels and trends in the NFHS-4', *Economic and Political Weekly*, 53(9), pp. 10-13.
- Dandona, R., Pandey, A. and Dandona, L. (2016). *A review of national health surveys in India*. Bulletin of the World Health Organization, 94(4), pp. 286-296A.
- Dehury, B. and Mohanty, S. K. (2015). *Regional Estimates of Multidimensional Poverty in India*. Economics. Kiel Institute for the World Economy, Vol, 9.
- Dhirar, N., Dudeja, S., Khandekar, J. and Bachani, D. (2018). 'Childhood morbidity and mortality in India- Analysis of National Family Health Survey 4 (NFHS-4) findings', *Indian Pediatrics*, 55(4), pp. 335-338.
- Foster, J., Greer, J. and Thorbecke, E. (2010). 'The Foster-Greer-Thorbecke (FGT) poverty measures: 25 years later', *The Journal of Economic Inequality*, 8(4), pp. 491-524.
- Foster, J.E. and Shorrocks, A., (1988). 'Poverty orderings and welfare dominance', *Social Choice and Welfare* 5, pp. 179-198.
- Foster, J., Greer, J. and Thorbecke, E. (1984). 'A class of decomposable poverty measures', *Econometrica*, 52(3), pp. 761-766.
- Government of India (GOI). (2012). *Press Note on Poverty Estimates, 2009-10*, New Delhi: Planning Commission, March 19.
- Hanandita, W. and Tampubolon, G. (2016). 'Multidimensional poverty in Indonesia: Trend over the last decade (2003–2013)', *Social Indicators Research*, 128(2), pp. 559-587.
- International Institute for Population Sciences (IIPS) and ICF. (2017). *National Family Health Survey (NFHS-4), 2015-16: India*. Mumbai: IIPS.
- International Institute for Population Sciences (IIPS) and Macro International. (2007). *National Family Health Survey (NFHS-3), 2005–06, India, Volume I and II*, Mumbai: IIPS.
- Jindra, C. and Vaz, A. (2019). 'Good governance and multidimensional poverty: A comparative analysis of 71 countries', *Governance*, 32(4), pp. 657-675.
- Lasso de la Vega, M. C. (2010). 'Counting Poverty Orderings and Deprivation Curves', in J. A. Bishop (ed.), *Studies in Applied Welfare Analysis: Papers from the Third ECINEQ Meeting*. *Research on Economic Inequality* 18, ch. 7.
- Lucci, P., Bhatkal, T. and Khan, A. (2018). 'Are we underestimating urban poverty?', *World Development*, 103, pp. 297-310.

- Mishra, A. and Ray, R. (2013). 'Multi-dimensional deprivation in India during and after the reforms: Do the household expenditure and the family health surveys present consistent evidence?', *Social Indicators Research*, 110(2), pp. 791-818.
- Mohanty, S. K., Agrawal, N. K., Mahapatra, B., Choudhury, D., Tuladhar, S. and Holmgren, E. V. (2017). 'Multidimensional poverty and catastrophic health spending in the mountainous regions of Myanmar, Nepal and India', *International Journal for Equity in Health*, 16(1).
- Nayyar, G. and Nayyar, R. (2016). 'India's "poverty of numbers": revisiting measurement issues', *Economic and Political Weekly*, vol. LI (35), pp.61-71.
- NFHS-4 Research Collaborators. (2017). 'National Family Health Survey-4 (2015-16)', *Economic and Political Weekly*, Vol. LII, No. 16: pp. 66-70.
- NFHS-4 Research Collaborators. (2016). 'Demographic and health trends in India (2005/06 – 2015/16)', *Economic and Political Weekly*, vol. LI (14), pp. 79–83.
- Ogutu, S. O. and Qaim, M. (2019). 'Commercialization of the small farm sector and multidimensional poverty', *World Development*, 114, pp. 281-293.
- OPHI (2018). *Global multidimensional poverty index 2018: The most detailed picture to date of the world's poorest people*, Oxford Poverty and Human Development Initiative, University of Oxford.
- Paul, P. (2019). 'Effects of education and poverty on the prevalence of girl child marriage in India: A district-level analysis', *Children and Youth Services Review*, 100, pp. 16–21.
- Pen, J. (1971). *Income distribution: facts, theories and policies*. New York: Praeger Publications.
- Sen, A. (1976). 'Poverty: An ordinal approach to measurement', *Econometrica: Journal of the Econometric Society*, 44(2), pp. 219-231.
- Spears, D., Ghosh, A. and Cumming, O. (2013). 'Open defecation and childhood stunting in India: An ecological analysis of new data from 112 districts', *PloS One*, 8(9).
- Suppa, N. (2018). 'Towards a multidimensional poverty index for Germany', *Empirica*, 45(4), pp. 655-683.
- Thorat, A., Vanneman, R., Desai, S. and Dubey, A. (2017). 'Escaping and falling into poverty in India today', *World Development*, 93, pp. 413-426.
- United Nations, Department of Economics and Social Affairs, Population Division (2017). *World Population Prospects: The 2017 Revision*, DVD Edition [Accessed on 28 April 2019].
- United Nations (UN) India. (2015). *India and the MDGs: Towards a sustainable future for all*. United Nations Economic and Social Commission for Asia and the Pacific: India. Retrieved from [https://www.unescap.org/sites/default/files/India\\_and\\_the\\_MDGs\\_0.pdf](https://www.unescap.org/sites/default/files/India_and_the_MDGs_0.pdf)
- United Nations. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. A/RES/70/1.
- United Nations Development Program. (2010). *Human Development Report 2010: The Real Wealth of Nations*, New York: Oxford University Press.
- Vollmer, F. and Alkire, S. (2018). 'Towards a global asset indicator: Re-assessing the asset indicator in the global multidimensional poverty index', OPHI Research in Progress 53a, Oxford Poverty and Human Development Initiative, University of Oxford.
- World Bank. (2017). *Monitoring global poverty: Report of the commission on global poverty*, Washington, DC: World Bank.

## Appendix A

Table A.1 A comparison of population shares by area, states and subgroups between Census 2011, NFHS 3 (2005/6) and NFHS 4 (2015/16)

	Population Share (in %)				
	Census 2011	Based on retained sample (weighted)		Based on full sample (weighted)	
		NFHS 3 2005/06	NFHS 4 2015/16	NFHS 3 2005/06	NFHS 4 2015/16
<b>Area</b>					
Rural	68.86	69.84	67.67	68.94	66.91
Urban	31.14	30.16	32.33	31.06	33.09
<b>States</b>					
Andhra Pradesh	6.99	7.21	6.57	7.04	7.10
Arunachal Pradesh	0.11	0.11	0.09	0.11	0.09
Assam	2.58	2.66	2.46	2.66	2.44
Bihar	8.60	7.96	8.95	7.90	8.75
Chhattisgarh	2.11	2.26	2.30	2.18	2.26
Delhi	1.39	0.95	1.17	1.19	1.49
Goa	0.12	0.13	0.12	0.14	0.12
Gujarat	4.99	4.88	4.70	4.84	4.79
Haryana	2.09	1.94	2.35	1.93	2.29
Himachal Pradesh	0.57	0.58	0.53	0.56	0.53
Jammu & Kashmir	1.04	0.93	0.98	0.95	0.96
Jharkhand	2.72	2.69	2.67	2.74	2.68
Karnataka	5.05	5.49	4.86	5.66	4.87
Kerala	2.76	2.59	2.98	2.54	2.88
Madhya Pradesh	6.00	6.52	6.58	6.25	6.48
Maharashtra	9.28	9.19	9.46	9.59	9.71
Manipur	0.24	0.21	0.18	0.20	0.18
Meghalaya	0.25	0.26	0.31	0.27	0.23
Mizoram	0.09	0.09	0.09	0.09	0.08
Nagaland	0.16	0.15	0.12	0.14	0.12
Orissa	3.47	3.64	3.45	3.64	3.42
Punjab	2.29	2.48	2.26	2.46	2.28
Rajasthan	5.66	5.98	5.59	5.76	5.47
Sikkim	0.05	0.06	0.04	0.06	0.04
Tamil Nadu	5.96	5.53	6.75	5.32	6.54
Tripura	0.30	0.34	0.29	0.33	0.29
Uttar Pradesh	16.50	16.42	15.76	16.88	15.54
Uttarakhand	0.83	0.78	0.83	0.82	0.82
West Bengal	7.54	7.96	7.56	7.76	7.53
<b>Age groups</b>					
Census Age Group 0-6	13.59	15.24	12.49	15.51	12.57
Census Age Group 7-14	17.17	19.15	15.83	19.10	15.78
Census Age Group 15-59	60.29	57.00	61.28	56.79	61.26
Census Age Group 60+	8.58	8.61	10.40	8.59	10.39
<b>Castes</b>					
Scheduled Caste	16.63	19.10	20.70	19.07	20.62
Scheduled Tribe	8.63	8.56	9.41	8.47	9.35
Other Backward Classes	NA	40.28	43.04	40.04	42.74
Other	NA	29.02	22.49	29.38	22.90
<b>Religion</b>					
Hindu	79.80	80.42	80.17	80.08	80.17
Muslim	14.23	14.01	14.13	14.31	14.15
Christian	2.30	2.28	2.36	2.28	2.35
Other	3.69	3.27	3.34	3.30	3.33

Table A.1 shows population shares as a percent of total population. For robust estimates of changes over time across area, states and subgroups it is important to understand whether major population and sampling changes took place. Naturally, the precision of demographic assessments from repeated cross-section data is limited, and we do not include a detailed review of migration status of households within

states. In addition to the survey data, the India Census 2011 upon which the 2015/16 sample draws, which was conducted midway between the time period of NFHS 3 and 4, is used as a further point of reference.

We report two population shares for each NFHS round: the retained sample employed to calculate the MPI, and the full NFHS sample. There are minor differences between the two surveys, due to the methodological choice to drop households for whom there are missing values in any of the 10 MPI indicators. Evidently, the difference in population shares between the full and retained sample for the same year low in magnitude and never exceeds 0.89 percentage point. We therefore restrict the following analysis of the samples and population shares to the retained MPI sample.

The difference between the two rounds of NFHS 3 and NFHS 4 can be substantial at times. For instance, the demographic shift from rural to urban areas is visible, as the difference for rural and urban areas between the two years is about 2 percentage points. Comparing the NFHS figures with the Census 2011, we see that as expected, ordinarily the Census 2011 figure lies between the two survey years. We see a similar pattern of demographic shifts for age groups. While the share of younger age-groups of 0-6 years and 7-14 has reduced over time, the share of older age groups has increased equivalently with the NFHS 3 figure of 2005/6 being the lowest, followed by the Census 2011 estimate and the NFHS 4 figure of 2015/16.

The population shares of religious groups have been stable over time and across surveys, whereas within caste groups, the share of Other Backward Classes has increased over time according to the NFHS figures (the Census 2011 does not report on this group). With regards to population shares by state, more complex shifts are visible. While the Census 2011 is expected to lie in between the two years of the NFHS rounds, this is not always the case. For instance, in the case of Delhi, according to the NFHS the population share has been rising from 1.19 percent to 1.49 percent between 2005/6 and 2015/16, whereas the Census 2011 reports a figure of 1.4 percent. For Chhattisgarh, the pattern is reverse with the Census 2011 being the lowest and the NFHS figures rising over the years. In the case of Delhi, the difference in population shares is relatively large, as the relative difference between NFHS 2005/6 and Census 2011 is about 20 percent. Differences of a similar magnitude affect some other smaller states. Also, the state of Karnataka witnesses a decreasing trend in its population share, although the Census 2011 reassuringly lies in between the two NFHS estimates.



**Table A.2 A comparison of population shares by area and household size between NFHS 3 and NFHS 4**

		Household Size							
		1	2	3	4	5	6	7	8+
NFHS 3 2005/6	Rural	1.04	4.55	8.04	15.47	18.55	16.26	11.63	24.46
	Urban	1.29	4.78	10.63	20.77	20.04	14.51	9.07	18.92
NFHS 4 2015/16	Rural	0.85	4.83	9.33	18.62	19.9	16.62	10.85	18.99
	Urban	1.06	5.68	12.48	23.92	20.06	14.25	7.84	14.71

Source: Authors' calculations based on retained MPI sample.

Naturally, the NFHS 3 sampling frame was based on the Census 2001, and this also will affect results. As indicated in Table A.2, we find that in both NFHS years, rural households tend to have more household members, but we see a decline in the average size for both rural and urban areas with a concentration toward 4-member/5-member households.

**Table A.3 A comparison of population shares by area and household size between NFHS 3 and NFHS 4**

		Age Group								
		0-10	11-17	18-24	25-30	31-39	40-49	50-59	60-69	70+
NFHS 3 2005/6	Rural	27.22	15.07	11.8	10.64	9.84	9.51	6.91	5.63	3.38
	Urban	20.57	14.48	14.26	11.85	12.12	11.19	7.89	4.74	2.91
NFHS 4 2015/16	Rural	21.75	14.24	12.52	10.27	10.77	10.9	8.74	6.77	4.03
	Urban	17.34	12.68	13.29	11.61	12.94	12.81	9.8	6.15	3.37

Source: Authors' calculations based on retained MPI sample.

In terms of age groups (Table A.3), rural areas have higher shares of children (0-17) than urban areas in both years. At the same time, we notice a demographic shift towards an aging population in both rural and urban areas. The share of children (below 18 years of age) decreases from 42.3 percent in 2005/06 to 36.0 percent in 2015/16 in rural areas, and from 35.1 percent to 30.0 percent in urban areas.

## Appendix B

### B.1 Harmonised indicators

We harmonized the MPI indicators using data from NFHS 3 (2005/6) and 4 (2015/16) following the global standard specified in Alkire, Kanagaratnam and Suppa (2019). Table B.1 illustrates the dimensions, indicators and deprivation cutoffs that are similar to global MPI 2019, with minor adjustment to reflect the country specific details applied in this paper.

**Table B.1 Indicator details**

Dimension	Indicator	Deprived if...
Health (1/3)	Nutrition	Any person 0-54 years of age for whom there is nutritional information in NFHS is <b>undernourished</b> .
	Child mortality	A <b>child under 18 has died</b> in the household in the five-year period preceding the survey.
Education (1/3)	Years of schooling	<b>No</b> household member aged 10 years or older has completed <b>six years</b> of schooling.
	School attendance	<b>Any</b> school-aged child 6-14 years is <b>not attending school</b> up to the age at which he/she would complete class 8.
Living Standards (1/3)	Cooking fuel	A household cooks using <b>solid fuel</b> , such as dung, agricultural crop, shrubs, wood, charcoal or coal.
	Sanitation	The household's <b>sanitation facility is not improved</b> or it is improved but <b>shared</b> with other households.
	Drinking water	The household's <b>source of drinking water is not safe</b> or safe drinking water is <b>at least a 30-minute walk</b> from home, roundtrip.
	Electricity	The household has <b>no electricity</b> .
	Housing	The household has <b>inadequate housing</b> : the floor is of natural materials or the roof or wall are of rudimentary materials.
Assets	The household does <b>not own more than one of these assets</b> : radio, TV, telephone, computer, animal cart, bicycle, motorbike, or refrigerator, and does not own a car or truck.	

Note: Table adapted from Alkire, Kanagaratnam and Suppa (2019), with minor modification applied for the purpose of this paper. The modification specifies the age specific cutoffs applied for the nutrition and school attendance indicators to reflect country level decision using NFHS 3 and 4 datasets.

**Nutrition:** In the third and fourth rounds of the NFHS surveys, the nutrition indicator is constructed using information from all children under 5 years, all women 15 to 49 years and a subsample of men aged 15-54 years – a configuration of data that is shared by 13 DHS surveys in the 2019 global MPI estimations. It should be noted that a wider set of nutrition information is available for households that house eligible child, women and men with anthropometric data, than for households that house a single eligible child, woman or man. Thus we construct the final nutrition indicator by making use of all available anthropometric information, but recognize that this involves some incomparabilities across households based on household demographics and whether the men are included in the subsample.

**Child mortality:** The child mortality indicator is based on birth history data provided by mothers aged 15–49. The subsample of men have provided information on occurrence of child mortality as well but this lacks the date of birth and death of the child. Hence, the indicator is constructed solely from mothers.

However, if the data from the mother is missing, and if the male in the household reported no child mortality, then we identify no occurrence of child mortality in the household across NFHS 3 and 4.

**Years of schooling:** We identified a household as deprived if all household member aged 10 years or older have less than six years of schooling. The same age and schooling specification was applied in the data for NFHS 3 and 4.

**School attendance:** Compulsory primary schooling in India begin at the age of 6 years. The age of compulsory schooling remain the same between 2005/06 and 2015/16 based on the data listed on UNESCO's UIS database and the NFHS survey reports. We identified households as deprived if there was any child between the ages of 6 to 14 years living in those household who were not attending school. The question on school attendance was perfectly comparable across NFHS 3 and 4.

**Cooking fuel:** The type of fuel that household mainly use for cooking was comparable across both survey periods. We then grouped these fuels into improved and non-improved categories following the SDG guideline on Affordable & Clean Energy (SDG 7).

**Sanitation:** The categories covering the type of toilet facilities used by household members was perfectly comparable between the NFHS 3 and 4 questionnaires. These categories were then grouped into improved and non-improved sanitation facility using the guideline provided in the survey reports of both time period.

**Drinking water:** The categories covering the main source of drinking water for members of household was to a large extent comparable between the NFHS 3 and 4 questionnaires. These categories were then grouped into improved and non-improved drinking facility using the guideline provided in the survey reports of both time period.

The NFHS 4 data identified an additional source of drinking water, which is the community RO plant. This category of source of drinking water did not exist in NFHS 3. We identified all those who are drawing their source of drinking water from this particular category as non-deprived following the survey report.

In the survey report of NFHS 4, it was stated that the quality of bottled water is not known (IIPS 2017, p. 24). As such, we have identified all individuals using bottled water as deprived in the final drinking water indicator. Following this, we have applied the same decision while constructing the drinking water indicator using data from NFHS 3.

**Electricity:** The question on whether household has electricity was comparable across both survey periods.

**Housing:** The housing indicator was constructed using three components: floor, roof and walls. The specific materials used to construct floor, roof and walls were grouped by the survey report into three categories: natural, rudimentary and finished. Households were identified as using improved material if the floor was constructed from rudimentary or finished material, while roof and walls were only considered improved if the materials were of finished standard. Household were considered non-deprived only if all three components were constructed using improved materials. The grouping of the various materials by natural, rudimentary and finished categories were comparable between NFHS 3 and 4 as listed in survey reports.

**Assets:** We took into account of 8 small assets - radio, TV, telephone, computer, animal cart, bicycle, motorbike and refrigerator; and 1 big asset – car/truck. All asset variables were present and comparable across NFHS 3 & 4. We identified households as not deprived in assets if they owned two or more of the small assets or a car/truck.

## **B.2 Indian States and Union Territories**

The subnational coverage in NFHS 4 (2015/16) differed slightly from NFHS 3 (2005/6). We detail the differences and explain how we manage these differences in our computation over time.

**Telangana.** The state of Telangana was formed in 2014, splitting from the state of Andhra Pradesh. As such the state while exist as a separate sampling unit in 2015/16, it was not the case in 2005/6. Hence for the purpose of this paper, we collapse the state of Telangana back with the state of Andhra Pradesh. We labelled the merged states as Andhra Pradesh, so we are consistent with the 2005/6 label. This is only for the purpose enabling us to analyse the changes in poverty estimates over time and for comparison across states.

**Chandigarh, Punjab and Haryana.** In NFHS 3 (2005/6), the sampling units that formed the state of Chandigarh was part of the two neighbouring states of Punjab and Haryana. In NFHS 4 (2015/16), these sampled areas independently made up the state of Chandigarh. However for comparison over time, we regrouped the state of Chandigarh with the state of Punjab.

**Union Territories.** India has five Union Territories: Andaman & Nicobar, Dadra & Nagar Haveli, Daman & Diu, Lakshadweep and Puducherry. These areas were not sampled in NFHS 2005/6 but were covered in the NFHS 2015/16. For comparison over time by state, these Union Territories are excluded. However, the national, rural-urban, and subgroup estimates for 2015/16 cover these areas.

## Appendix C

**Table C.1 Annualized absolute change in uncensored (raw) headcount ratio by indicator (in percentage points) between 2005/6 and 2015/16**

		Nutrition	Child Mortality	Years of Schooling	School Attendance	Cooking Fuel	Sanitation	Drinking Water	Electricity	Housing	Assets
National		-19.7 ***	-2.1 ***	-11.1 ***	-14.9 ***	-15.9 ***	-18.9 ***	-7.3 ***	-20.8 ***	-10.2 ***	-32.9 ***
Area											
Rural		-20.6 ***	-2.5 ***	-13.6 ***	-16.8 ***	-14.3 ***	-18.8 ***	-9.8 ***	-27.4 ***	-12.1 ***	-37.6 ***
Urban		-16.8 ***	-1.2 ***	-4.6 ***	-10.2 ***	-15.3 ***	-16.8 ***	-1.1 ***	-4.5 ***	-2.8 ***	-21.0 ***
States											
Andhra Pradesh*	AP	-25.0 ***	-1.1 ***	-12.4 ***	-12.4 ***	-31.6 ***	-21.3 ***	10.7 ***	-8.5 ***	-22.0 ***	-38.0 ***
Arunachal	AR	-21.8 ***	-4.6 ***	-15.1 ***	-28.1 ***	-14.7 ***	-21.2 ***	-4.1 ***	-12.3 ***	-3.3 ***	-37.3 ***
Assam	AS	-15.1 ***	-2.2 ***	-9.5 ***	-10.0 ***	-2.6 ***	-17.0 ***	-11.9 ***	-42.1 ***	-5.4 ***	-33.6 ***
Bihar	BH	-16.8 ***	-3.5 ***	-14.4 ***	-31.8 ***	-7.6 ***	-9.8 ***	-4.9 ***	-31.0 ***	-4.8 ***	-37.0 ***
Chhattisgarh	CT	-21.0 ***	-3.0 ***	-18.0 ***	-15.4 ***	-9.4 ***	-19.3 ***	-16.8 ***	-22.2 ***	-14.4 ***	-33.1 ***
Delhi	DL	-4.1 ***	-0.4 ***	-3.9 ***	-7.8 ***	-7.7 ***	-9.7 ***	6.6 ***	-0.5 ***	5.5 ***	-11.3 ***
Goa	GA	-13.1 ***	-0.2 ***	-2.7 ***	-7.1 ***	-22.0 ***	-16.9 ***	-17.8 ***	-2.6 ***	-11.4 ***	-17.5 ***
Gujarat	GJ	-14.7 ***	-1.7 ***	-7.5 ***	-6.4 ***	-5.6 ***	-18.5 ***	-3.8 ***	-6.1 ***	-8.5 ***	-25.7 ***
Haryana	HR	-16.9 ***	-1.3 ***	-7.9 ***	-14.0 ***	-22.2 ***	-39.7 ***	-6.7 ***	-7.3 ***	-16.0 ***	-27.5 ***
Himachal Pradesh	HP	-19.2 ***	0.0 ***	-3.9 ***	-4.5 ***	-6.4 ***	-35.2 ***	-10.9 ***	-1.2 ***	-18.0 ***	-27.4 ***
Jammu & Kashmir	JK	-16.2 ***	-1.5 ***	-5.2 ***	-17.5 ***	-20.4 ***	-30.5 ***	-11.9 ***	-3.4 ***	-21.3 ***	-21.6 ***
Jharkhand	JH	-17.1 ***	-4.2 ***	-15.9 ***	-28.0 ***	-8.1 ***	-9.1 ***	-23.2 ***	-40.9 ***	-9.0 ***	-34.3 ***
Karnataka	KA	-24.3 ***	-1.7 ***	-7.8 ***	-13.7 ***	-22.8 ***	-24.2 ***	-13.1 ***	-7.8 ***	-9.3 ***	-34.8 ***
Kerala	KL	-15.9 ***	-0.5 ***	-1.6 ***	-4.0 ***	-30.1 ***	-6.6 ***	-27.2 ***	-7.6 ***	-3.8 ***	-25.8 ***
Madhya Pradesh	MP	-18.9 ***	-2.6 ***	-14.6 ***	-17.3 ***	-11.1 ***	-15.5 ***	-19.4 ***	-18.2 ***	-9.8 ***	-35.8 ***
Maharashtra	MH	-22.1 ***	-1.1 ***	-5.4 ***	-8.1 ***	-11.9 ***	-20.8 ***	-0.3 ***	-9.5 ***	-14.0 ***	-26.1 ***
Manipur	MN	-16.9 ***	-1.1 ***	-4.1 ***	-18.3 ***	-6.3 ***	-19.4 ***	6.3 ***	-4.6 ***	-6.4 ***	-19.9 ***
Meghalaya	ML	-10.7 ***	-1.2 ***	-13.8 ***	-34.6 ***	0.5 ***	-22.4 ***	-7.8 ***	-21.5 ***	-8.0 ***	-36.1 ***
Mizoram	MZ	-14.9 ***	-1.2 ***	-1.7 ***	-10.4 ***	-3.7 ***	-7.4 ***	-9.3 ***	-3.3 ***	-52.9 ***	-37.6 ***
Nagaland	NL	-19.4 ***	-3.2 ***	-10.4 ***	-30.7 ***	-9.1 ***	-28.5 ***	-21.3 ***	-15.3 ***	-6.6 ***	-30.8 ***
Odisha	OR	-19.9 ***	-2.4 ***	-14.6 ***	-11.4 ***	-8.7 ***	-12.9 ***	-12.7 ***	-37.8 ***	-11.1 ***	-37.1 ***
Punjab*	PB	-12.6 ***	-1.0 ***	-7.5 ***	-11.9 ***	-23.5 ***	-28.6 ***	-0.2 ***	-2.7 ***	-13.1 ***	-14.9 ***
Rajasthan	RJ	-16.8 ***	-3.3 ***	-13.8 ***	-18.5 ***	-10.8 ***	-27.1 ***	-9.1 ***	-25.1 ***	-15.0 ***	-33.4 ***
Sikkim	SK	-13.0 ***	-0.8 ***	-17.0 ***	-22.1 ***	-14.6 ***	-26.6 ***	-21.9 ***	-7.5 ***	-21.3 ***	-44.4 ***
Tamil Nadu	TN	-19.3 ***	-0.2 ***	-10.4 ***	-3.6 ***	-36.7 ***	-29.9 ***	-10.1 ***	-9.0 ***	-9.2 ***	-38.0 ***
Tripura	TR	-24.7 ***	-2.0 ***	-13.0 ***	-9.7 ***	-17.5 ***	-8.8 ***	-19.6 ***	-24.7 ***	-13.9 ***	-35.2 ***
Uttar Pradesh	UP	-22.0 ***	-3.1 ***	-10.1 ***	-18.1 ***	-15.6 ***	-15.0 ***	-5.1 ***	-28.6 ***	-4.0 ***	-33.8 ***
Uttarakhand	UT	-15.2 ***	-0.3 ***	-4.1 ***	-5.8 ***	-12.4 ***	-21.4 ***	-10.2 ***	-16.4 ***	-14.2 ***	-26.8 ***
West Bengal	WB	-21.6 ***	-2.0 ***	-17.3 ***	-14.5 ***	-9.7 ***	-16.8 ***	-3.6 ***	-42.8 ***	-7.8 ***	-36.9 ***
Age groups											
Children (0-17)		-19.0 ***	-2.5 ***	-12.5 ***	-19.6 ***	-14.7 ***	-17.4 ***	-8.1 ***	-23.0 ***	-9.6 ***	-35.7 ***
Adults (18+)		-19.2 ***	-1.8 ***	-9.8 ***	-11.1 ***	-15.7 ***	-19.0 ***	-6.6 ***	-18.7 ***	-9.7 ***	-30.6 ***
0-9		-15.6 ***	-2.8 ***	-12.9 ***	-21.0 ***	-15.5 ***	-17.9 ***	-8.6 ***	-24.6 ***	-10.9 ***	-36.7 ***
10-17		-22.0 ***	-2.0 ***	-11.4 ***	-18.0 ***	-13.7 ***	-16.5 ***	-7.5 ***	-20.7 ***	-7.8 ***	-34.3 ***
18-59		-19.7 ***	-1.8 ***	-9.8 ***	-11.4 ***	-15.4 ***	-18.7 ***	-6.6 ***	-18.5 ***	-9.3 ***	-30.9 ***
60+		-14.8 ***	-1.5 ***	-10.8 ***	-9.0 ***	-17.4 ***	-20.5 ***	-7.1 ***	-20.4 ***	-12.1 ***	-29.9 ***
Castes											
Scheduled Caste		-22.5 ***	-2.8 ***	-14.1 ***	-16.1 ***	-16.1 ***	-18.9 ***	-7.8 ***	-26.0 ***	-12.1 ***	-41.2 ***
Scheduled Tribe		-19.8 ***	-3.4 ***	-20.4 ***	-20.6 ***	-8.0 ***	-15.1 ***	-16.3 ***	-32.5 ***	-12.5 ***	-39.8 ***
Other Backward Classes		-21.1 ***	-2.1 ***	-11.3 ***	-16.1 ***	-19.7 ***	-23.6 ***	-9.1 ***	-20.1 ***	-12.5 ***	-34.8 ***
Other		-17.6 ***	-1.4 ***	-7.4 ***	-11.5 ***	-16.4 ***	-18.2 ***	-2.6 ***	-15.4 ***	-8.4 ***	-23.6 ***
Religion											
Hindu		-20.1 ***	-2.1 ***	-10.7 ***	-13.8 ***	-14.9 ***	-18.6 ***	-7.7 ***	-20.4 ***	-9.9 ***	-33.0 ***
Muslim		-19.0 ***	-2.6 ***	-15.2 ***	-22.0 ***	-21.2 ***	-20.8 ***	-5.3 ***	-25.5 ***	-11.9 ***	-35.5 ***
Christian		-17.3 ***	-1.4 ***	-7.0 ***	-12.3 ***	-16.7 ***	-15.9 ***	-11.8 ***	-15.6 ***	-10.9 ***	-30.9 ***
Other		-14.9 ***	-1.5 ***	-6.3 ***	-12.1 ***	-15.2 ***	-21.3 ***	-2.2 ***	-11.7 ***	-9.7 ***	-20.5 ***

## Notes

i. All figures presented in Table C.1 is based on author's calculation with NFHS 3 (2005/6) and NFHS 4 (2015/16) data.

ii. The t-statistics for difference show that the absolute and relative changes are statistically significant at 1% (\*\*\*) for national, rural and urban areas, states and all population subgroups.

iii. Absolute change in uncensored (raw) headcount ratio is defined as the change in the proportion of people who are deprived in a given indicator between 2015/16 and 2005/6, regardless whether they are multidimensionally poor or not.

iv. \*Andhra Pradesh includes the state of Telangana; Punjab includes the state of Chandigarh (see Appendix B for details).

**Table C.2 Annualized relative change in uncensored (raw) headcount ratio by indicator (in percentage points) between 2005/6 and 2015/16**

		Nutrition	Child Mortality	Years of Schooling	School Attendance	Cooking Fuel	Sanitation	Drinking Water	Electricity	Housing	Assets
National		-34.4	-44.0	-44.5	-69.9	-21.3	-26.7	-33.3	-63.1	-18.3	-70.2
<i>Area</i>											
Rural		-32.7	-43.7	-44.5	-69.0	-15.6	-23.0	-37.3	-62.0	-16.9	-67.9
Urban		-37.8	-41.6	-38.5	-71.7	-44.9	-36.6	-9.1	-64.7	-14.5	-78.0
<i>States</i>											
Andhra Pradesh*	AP	-46.9	-40.4	-42.9	-84.7	-47.2	-30.9	53.5	-89.8	-51.3	-76.4
Arunachal	AR	-50.8	-70.1	-45.9	-77.5	-20.2	-35.3	-21.5	-50.9	-4.2	-61.5
Assam	AS	-27.6	-43.1	-37.0	-60.4	-3.2	-24.9	-40.3	-65.9	-6.7	-62.8
Bihar	BH	-24.4	-43.5	-35.4	-71.8	-8.4	-11.7	-67.8	-43.7	-6.1	-60.3
Chhattisgarh	CT	-32.8	-47.2	-57.2	-74.2	-10.7	-22.8	-47.9	-85.9	-18.5	-68.9
Delhi	DL	-15.0	-16.7	-39.4	-74.6	-77.8	-26.7	38.9	-63.2	104.4	-66.9
Goa	GA	-34.7	-22.7	-36.8	-88.1	-59.6	-44.1	-81.3	-93.4	-41.3	-85.5
Gujarat	GJ	-26.2	-43.6	-43.4	-49.1	-10.3	-33.2	-23.4	-61.8	-25.9	-65.4
Haryana	HR	-34.4	-38.0	-52.7	-78.6	-30.2	-67.3	-34.7	-87.3	-39.8	-85.6
Himachal Pradesh	HP	-41.3	-0.3	-50.9	-83.6	-8.6	-55.9	-57.9	-71.9	-38.1	-78.5
Jammu & Kashmir	JK	-38.4	-44.3	-43.2	-82.5	-31.0	-39.3	-45.6	-55.0	-41.8	-57.3
Jharkhand	JH	-26.2	-55.8	-46.4	-77.4	-9.0	-10.8	-42.8	-68.5	-12.8	-61.6
Karnataka	KA	-42.0	-56.3	-47.3	-79.5	-33.4	-35.9	-47.4	-82.0	-20.0	-77.6
Kerala	KL	-50.9	-71.6	-48.1	-88.1	-40.7	-78.0	-82.1	-90.8	-26.1	-89.6
Madhya Pradesh	MP	-29.3	-42.0	-47.6	-67.4	-13.5	-19.2	-39.5	-67.0	-13.2	-65.0
Maharashtra	MH	-38.0	-43.1	-45.3	-65.9	-23.1	-30.3	-2.0	-59.1	-33.4	-65.2
Manipur	MN	-41.8	-38.4	-43.6	-88.6	-9.6	-29.0	11.5	-38.6	-7.3	-58.8
Meghalaya	ML	-22.4	-28.5	-41.2	-84.9	0.6	-36.7	-18.9	-72.4	-13.7	-54.8
Mizoram	MZ	-41.1	-34.4	-17.4	-73.4	-10.4	-32.0	-49.6	-44.5	-68.6	-72.9
Nagaland	NL	-44.2	-60.8	-43.4	-86.4	-11.6	-55.1	-50.1	-82.5	-8.5	-47.6
Odisha	OR	-34.7	-51.6	-46.7	-69.7	-9.7	-15.5	-37.7	-73.9	-16.6	-65.9
Punjab*	PB	-36.2	-42.7	-50.9	-82.3	-39.9	-62.2	-9.9	-87.6	-40.9	-89.5
Rajasthan	RJ	-28.2	-52.8	-44.6	-68.6	-13.3	-33.4	-25.4	-74.2	-29.7	-62.0
Sikkim	SK	-49.3	-45.2	-67.5	-93.9	-25.6	-71.9	-90.4	-92.0	-44.3	-82.3
Tamil Nadu	TN	-43.7	-14.2	-61.2	-77.9	-60.4	-38.6	-44.5	-90.3	-31.3	-91.8
Tripura	TR	-46.7	-61.1	-54.7	-81.7	-21.0	-19.5	-54.6	-77.4	-15.7	-65.3
Uttar Pradesh	UP	-33.1	-38.1	-36.5	-60.3	-18.5	-19.1	-48.7	-51.1	-5.5	-73.1
Uttarakhand	UT	-31.7	-11.5	-29.5	-56.8	-19.3	-38.5	-53.0	-88.3	-28.5	-66.0
West Bengal	WB	-39.1	-56.7	-52.2	-79.1	-11.7	-25.9	-23.6	-88.2	-12.6	-72.3
<i>Age groups</i>											
Children (0-17)		-30.0	-43.3	-44.2	-65.9	-18.5	-22.9	-35.3	-59.5	-15.6	-69.0
Adults (18+)		-36.0	-42.6	-43.3	-71.4	-22.1	-28.1	-31.5	-64.5	-18.6	-70.4
0-9		-22.1	-40.0	-38.0	-68.5	-19.2	-23.1	-36.3	-60.3	-17.2	-67.6
10-17		-40.7	-47.6	-53.9	-62.6	-17.6	-22.5	-33.8	-58.0	-13.3	-70.7
18-59		-35.7	-42.0	-46.5	-70.9	-22.0	-27.7	-31.2	-64.7	-18.1	-72.4
60+		-36.3	-45.4	-33.7	-73.7	-23.0	-30.0	-33.3	-63.7	-21.6	-61.4
<i>Castes</i>											
Scheduled Caste		-35.6	-47.7	-45.9	-68.7	-19.3	-23.2	-35.7	-63.7	-18.5	-71.8
Scheduled Tribe		-29.1	-51.4	-46.7	-65.5	-8.8	-16.9	-36.2	-64.9	-15.0	-57.0
Other Backward Classes		-35.5	-42.2	-45.7	-72.3	-25.4	-31.3	-39.7	-60.8	-22.1	-74.3
Other		-36.8	-43.0	-47.4	-73.4	-28.1	-34.4	-18.7	-70.1	-21.0	-72.2
<i>Religion</i>											
Hindu		-34.8	-43.9	-45.1	-71.4	-20.0	-25.4	-33.4	-61.9	-17.5	-70.5
Muslim		-31.6	-44.0	-42.8	-63.7	-27.5	-31.5	-34.2	-67.0	-21.2	-68.9
Christian		-40.7	-50.2	-41.3	-80.3	-26.3	-32.4	-36.6	-74.1	-24.4	-69.8
Other		-34.0	-46.0	-39.4	-77.0	-24.3	-38.9	-17.1	-69.7	-22.7	-69.9

*Notes*

i. All figures presented in Table C.2 is based on author's calculation with NFHS 3 (2005/6) and NFHS 4 (2015/16) data.

ii. The t-statistics for difference show that the absolute and relative changes are statistically significant at 1% (\*\*\*) for national, rural and urban areas, states and all population subgroups.

iii. Relative change in uncensored (raw) headcount ratio is defined as the relative change in the proportion of people who are deprived in a given indicator between 2015/16 and 2005/6 as a percentage of the initial level of deprivation.

iv. \*Andhra Pradesh includes the state of Telangana; Punjab includes the state of Chandigarh (see Appendix B for details).

**Table C.3 Annualized absolute change in censored headcount ratio by indicator (in percentage points) between 2005/6 and 2015/16**

		Nutrition	Child Mortality	Years of Schooling	School Attendance	Cooking Fuel	Sanitation	Drinking Water	Electricity	Housing	Assets
<i>National Area</i>		-23.1 ***	-2.3 ***	-12.3 ***	-14.2 ***	-26.7 ***	-25.8 ***	-10.4 ***	-20.4 ***	-21.3 ***	-28.0 ***
Rural		-26.8 ***	-2.7 ***	-14.9 ***	-16.6 ***	-31.7 ***	-30.4 ***	-13.0 ***	-27.0 ***	-26.3 ***	-34.4 ***
Urban		-13.0 ***	-1.2 ***	-5.6 ***	-8.5 ***	-13.1 ***	-13.3 ***	-3.8 ***	-4.4 ***	-7.5 ***	-12.6 ***
<i>States</i>											
Andhra Pradesh*	AP	-27.5 ***	-1.3 ***	-16.6 ***	-11.2 ***	-33.5 ***	-31.6 ***	-7.5 ***	-8.1 ***	-23.7 ***	-30.0 ***
Arunachal	AR	-25.2 ***	-4.9 ***	-17.6 ***	-25.1 ***	-32.7 ***	-27.9 ***	-9.8 ***	-13.7 ***	-32.6 ***	-34.2 ***
Assam	AS	-20.4 ***	-2.4 ***	-10.5 ***	-9.8 ***	-24.2 ***	-22.8 ***	-13.8 ***	-36.3 ***	-24.2 ***	-29.5 ***
Bihar	BH	-22.3 ***	-3.6 ***	-15.1 ***	-31.1 ***	-24.7 ***	-23.8 ***	-5.0 ***	-34.9 ***	-20.2 ***	-37.1 ***
Chhattisgarh	CT	-27.9 ***	-3.2 ***	-18.6 ***	-15.5 ***	-33.0 ***	-34.3 ***	-18.9 ***	-21.0 ***	-31.2 ***	-31.1 ***
Delhi	DL	-5.6 ***	-0.5 ***	-4.5 ***	-5.7 ***	-4.5 ***	-7.7 ***	-3.5 ***	-0.4 ***	-1.8 ***	-4.8 ***
Goa	GA	-11.9 ***	-0.2 ***	-3.6 ***	-5.3 ***	-13.5 ***	-11.7 ***	-9.4 ***	-2.3 ***	-10.8 ***	-11.0 ***
Gujarat	GJ	-14.6 ***	-1.7 ***	-8.3 ***	-6.2 ***	-15.4 ***	-16.6 ***	-7.0 ***	-5.9 ***	-12.3 ***	-18.8 ***
Haryana	HR	-23.0 ***	-1.7 ***	-9.0 ***	-12.8 ***	-28.4 ***	-27.5 ***	-9.2 ***	-6.7 ***	-20.2 ***	-21.0 ***
Himachal Pradesh	HP	-20.0 ***	-0.6 ***	-4.9 ***	-4.3 ***	-22.2 ***	-22.1 ***	-7.8 ***	-1.3 ***	-18.3 ***	-16.8 ***
Jammu & Kashmir	JK	-19.7 ***	-1.9 ***	-6.0 ***	-14.6 ***	-24.4 ***	-26.9 ***	-12.7 ***	-3.1 ***	-21.3 ***	-18.7 ***
Jharkhand	JH	-22.9 ***	-4.3 ***	-16.4 ***	-26.7 ***	-28.7 ***	-28.2 ***	-29.0 ***	-41.4 ***	-23.9 ***	-35.4 ***
Karnataka	KA	-28.5 ***	-1.5 ***	-9.1 ***	-12.9 ***	-30.5 ***	-30.3 ***	-14.0 ***	-7.4 ***	-22.6 ***	-27.1 ***
Kerala	KL	-10.1 ***	-0.5 ***	-2.1 ***	-2.2 ***	-12.1 ***	-3.7 ***	-8.0 ***	-4.2 ***	-5.7 ***	-10.0 ***
Madhya Pradesh	MP	-23.5 ***	-2.9 ***	-15.4 ***	-16.8 ***	-27.3 ***	-27.6 ***	-22.4 ***	-18.8 ***	-25.1 ***	-33.9 ***
Maharashtra	MH	-20.7 ***	-1.1 ***	-6.3 ***	-7.9 ***	-21.5 ***	-22.7 ***	-4.8 ***	-10.6 ***	-19.5 ***	-20.1 ***
Manipur	MN	-15.9 ***	-1.3 ***	-4.3 ***	-16.6 ***	-21.1 ***	-21.5 ***	-13.3 ***	-6.0 ***	-22.7 ***	-16.3 ***
Meghalaya	ML	-18.0 ***	-1.7 ***	-15.1 ***	-32.7 ***	-27.1 ***	-25.7 ***	-18.7 ***	-20.9 ***	-22.9 ***	-32.2 ***
Mizoram	MZ	-17.3 ***	-1.8 ***	-3.2 ***	-8.8 ***	-15.4 ***	-7.3 ***	-8.7 ***	-3.1 ***	-21.6 ***	-21.2 ***
Nagaland	NL	-22.5 ***	-3.4 ***	-11.8 ***	-27.7 ***	-30.6 ***	-28.1 ***	-21.7 ***	-15.0 ***	-30.3 ***	-30.1 ***
Odisha	OR	-23.2 ***	-2.5 ***	-15.8 ***	-11.5 ***	-28.3 ***	-28.9 ***	-16.5 ***	-35.0 ***	-23.3 ***	-33.7 ***
Punjab*	PB	-12.1 ***	-0.9 ***	-8.5 ***	-8.8 ***	-16.0 ***	-16.5 ***	-0.8 ***	-2.3 ***	-12.8 ***	-10.3 ***
Rajasthan	RJ	-23.6 ***	-3.5 ***	-15.3 ***	-18.1 ***	-30.2 ***	-31.8 ***	-16.4 ***	-23.8 ***	-22.2 ***	-31.0 ***
Sikkim	SK	-15.0 ***	-1.0 ***	-19.3 ***	-17.0 ***	-28.9 ***	-20.2 ***	-15.3 ***	-7.4 ***	-26.7 ***	-30.2 ***
Tamil Nadu	TN	-23.0 ***	-0.5 ***	-11.5 ***	-3.4 ***	-29.1 ***	-29.2 ***	-9.9 ***	-7.8 ***	-16.2 ***	-25.2 ***
Tripura	TR	-29.0 ***	-2.1 ***	-14.3 ***	-9.5 ***	-34.3 ***	-16.3 ***	-20.0 ***	-22.3 ***	-34.4 ***	-30.0 ***
Uttar Pradesh	UP	-26.0 ***	-3.4 ***	-11.1 ***	-17.9 ***	-28.5 ***	-27.1 ***	-6.8 ***	-29.8 ***	-22.6 ***	-31.1 ***
Uttarakhand	UT	-18.2 ***	-0.9 ***	-5.8 ***	-5.9 ***	-22.0 ***	-21.2 ***	-9.0 ***	-13.2 ***	-20.4 ***	-19.8 ***
West Bengal	WB	-26.6 ***	-2.1 ***	-19.0 ***	-13.9 ***	-31.5 ***	-25.5 ***	-7.2 ***	-37.7 ***	-25.8 ***	-32.6 ***
<i>Age groups</i>											
Children (0-17)		-24.4 ***	-2.7 ***	-13.5 ***	-19.0 ***	-27.8 ***	-26.9 ***	-11.3 ***	-23.3 ***	-21.9 ***	-31.8 ***
Adults (18+)		-21.2 ***	-1.9 ***	-11.2 ***	-10.5 ***	-25.0 ***	-24.1 ***	-9.6 ***	-18.0 ***	-19.8 ***	-25.1 ***
0-9		-24.3 ***	-3.1 ***	-14.2 ***	-20.2 ***	-27.1 ***	-26.4 ***	-11.6 ***	-24.8 ***	-21.2 ***	-33.6 ***
10-17		-23.6 ***	-2.1 ***	-12.0 ***	-17.6 ***	-27.9 ***	-26.9 ***	-10.8 ***	-21.2 ***	-22.2 ***	-29.3 ***
18-59		-21.8 ***	-2.0 ***	-10.9 ***	-10.8 ***	-24.9 ***	-24.0 ***	-9.6 ***	-17.8 ***	-19.7 ***	-25.3 ***
60+		-17.1 ***	-1.6 ***	-13.4 ***	-8.5 ***	-25.9 ***	-24.8 ***	-9.5 ***	-19.2 ***	-21.0 ***	-25.0 ***
<i>Castes</i>											
Scheduled Caste		-27.7 ***	-3.0 ***	-15.7 ***	-16.0 ***	-31.6 ***	-31.0 ***	-11.7 ***	-25.6 ***	-25.7 ***	-36.5 ***
Scheduled Tribe		-25.1 ***	-3.5 ***	-21.5 ***	-20.6 ***	-29.6 ***	-30.2 ***	-21.9 ***	-33.2 ***	-28.3 ***	-39.9 ***
Other Backward Classes		-25.9 ***	-2.3 ***	-12.6 ***	-15.7 ***	-30.6 ***	-30.1 ***	-11.8 ***	-20.2 ***	-23.4 ***	-29.4 ***
Other		-17.7 ***	-1.6 ***	-8.2 ***	-10.0 ***	-20.2 ***	-18.3 ***	-5.3 ***	-13.9 ***	-15.5 ***	-17.8 ***
<i>Religion</i>											
Hindu		-23.2 ***	-2.2 ***	-11.8 ***	-13.3 ***	-26.6 ***	-26.1 ***	-11.0 ***	-20.1 ***	-21.3 ***	-28.1 ***
Muslim		-25.0 ***	-2.9 ***	-17.1 ***	-21.0 ***	-29.9 ***	-26.8 ***	-7.6 ***	-25.5 ***	-22.8 ***	-30.9 ***
Christian		-17.4 ***	-1.5 ***	-8.1 ***	-11.5 ***	-21.9 ***	-18.6 ***	-11.1 ***	-14.6 ***	-18.0 ***	-21.6 ***
Other		-15.0 ***	-1.6 ***	-7.5 ***	-10.2 ***	-18.7 ***	-19.4 ***	-5.5 ***	-11.2 ***	-16.2 ***	-18.1 ***

*Notes*

i. All figures presented in Table C.3 is based on author's calculation with NFHS 3 (2005/6) and NFHS 4 (2015/16) data.

ii. The t-statistics for difference show that the absolute and relative changes are statistically significant at 1% (\*\*\*) for national, rural and urban areas, states and all population subgroups.

iii. Absolute change in censored headcount ratio is defined as the change in the proportion of people who are multidimensionally poor and deprived in a given indicator between 2015/16 and 2005/6

iv. \*Andhra Pradesh includes the state of Telangana; Pujab includes the state of Chandigarh (see Appendix B for details).

**Table C.4 Annualized relative change in censored headcount ratio by indicator (in percentage points) between 2005/6 and 2015/16**

		Nutrition	Child Mortality	Years of Schooling	School Attendance	Cooking Fuel	Sanitation	Drinking Water	Electricity	Housing	Assets
National		-52.1	-50.7	-51.4	-72.0	-50.6	-51.2	-62.5	-70.3	-47.3	-74.6
<i>Area</i>											
Rural		-48.9	-49.1	-49.8	-70.7	-47.1	-47.8	-61.0	-69.0	-44.9	-73.0
Urban		-65.1	-54.0	-54.6	-75.9	-67.7	-66.8	-67.9	-76.6	-58.3	-81.7
<i>States</i>											
Andhra Pradesh*	AP	-71.6	-53.7	-62.6	-88.2	-71.6	-68.5	-56.3	-91.6	-72.7	-81.5
Arunachal	AR	-66.5	-77.4	-55.3	-80.8	-59.5	-61.9	-58.9	-64.2	-58.2	-71.4
Assam	AS	-42.7	-48.3	-41.2	-62.4	-40.7	-44.8	-59.2	-69.8	-40.7	-66.7
Bihar	BH	-35.2	-45.8	-37.3	-72.2	-32.5	-32.8	-74.9	-54.6	-29.2	-66.4
Chhattisgarh	CT	-49.6	-53.0	-59.9	-76.6	-47.8	-50.2	-63.3	-87.7	-47.8	-73.7
Delhi	DL	-62.6	-33.0	-63.8	-83.1	-88.6	-71.6	-71.4	-84.2	-57.8	-74.8
Goa	GA	-72.2	-33.4	-61.0	-89.4	-78.0	-73.8	-95.2	-100.0	-76.3	-89.9
Gujarat	GJ	-45.4	-50.3	-53.3	-54.9	-43.2	-47.3	-55.7	-66.5	-46.5	-67.5
Haryana	HR	-72.4	-53.9	-65.0	-81.7	-75.6	-80.6	-74.1	-89.5	-73.2	-88.7
Himachal Pradesh	HP	-75.3	-41.8	-69.6	-90.6	-74.5	-78.2	-83.8	-83.2	-74.3	-84.9
Jammu & Kashmir	JK	-63.5	-59.2	-54.7	-84.8	-64.2	-67.0	-68.5	-63.0	-64.5	-71.2
Jharkhand	JH	-38.5	-58.3	-48.3	-77.8	-38.5	-38.9	-60.6	-74.4	-36.9	-68.4
Karnataka	KA	-69.3	-59.4	-58.3	-83.2	-66.3	-66.8	-76.0	-86.9	-62.9	-82.6
Kerala	KL	-92.7	-93.9	-86.9	-90.6	-92.8	-91.4	-95.8	-93.8	-89.4	-94.7
Madhya Pradesh	MP	-42.9	-47.3	-50.8	-68.4	-40.9	-42.0	-54.3	-72.9	-40.2	-70.2
Maharashtra	MH	-60.1	-52.9	-56.1	-71.7	-58.9	-60.5	-43.2	-74.6	-61.2	-72.5
Manipur	MN	-50.2	-47.7	-46.7	-89.4	-53.2	-60.7	-44.8	-61.4	-52.6	-69.2
Meghalaya	ML	-44.3	-40.1	-46.3	-85.6	-45.8	-56.6	-55.2	-75.8	-48.2	-61.8
Mizoram	MZ	-75.6	-66.5	-35.7	-78.7	-64.0	-54.8	-74.7	-50.6	-73.5	-75.1
Nagaland	NL	-59.9	-68.3	-50.0	-88.2	-57.2	-75.9	-75.1	-86.2	-56.9	-63.6
Odisha	OR	-46.4	-56.5	-51.0	-71.5	-44.4	-46.2	-59.8	-78.7	-42.8	-70.5
Punjab*	PB	-74.0	-58.6	-69.1	-84.8	-77.3	-81.7	-62.2	-89.6	-75.7	-92.7
Rajasthan	RJ	-49.9	-58.9	-51.2	-70.5	-49.9	-53.4	-52.9	-77.0	-51.0	-68.0
Sikkim	SK	-82.7	-74.5	-85.6	-97.9	-88.1	-93.5	-97.3	-98.1	-88.8	-91.3
Tamil Nadu	TN	-81.9	-48.1	-78.8	-86.9	-83.0	-81.0	-85.6	-93.8	-77.2	-93.2
Tripura	TR	-67.6	-68.0	-60.5	-84.5	-64.4	-53.4	-70.0	-81.6	-63.5	-72.5
Uttar Pradesh	UP	-45.4	-43.9	-40.9	-62.7	-43.1	-43.2	-73.2	-61.0	-37.8	-77.2
Uttarakhand	UT	-57.6	-33.9	-44.6	-64.4	-58.4	-63.1	-72.9	-89.6	-61.3	-74.2
West Bengal	WB	-58.6	-64.3	-59.3	-81.6	-55.1	-53.6	-59.7	-90.4	-52.2	-77.3
<i>Age groups</i>											
Children (0-17)		-46.5	-48.8	-48.4	-68.1	-45.9	-46.6	-60.7	-66.6	-42.4	-73.1
Adults (18+)		-54.5	-50.1	-52.1	-73.5	-52.4	-53.0	-62.9	-71.8	-49.3	-74.9
0-9		-41.0	-45.5	-42.3	-69.8	-41.2	-41.8	-57.5	-64.7	-37.7	-70.3
10-17		-54.1	-53.2	-57.9	-65.7	-51.8	-52.7	-64.8	-68.9	-48.3	-76.9
18-59		-54.1	-49.5	-54.1	-73.1	-52.8	-53.4	-63.3	-72.2	-49.5	-76.9
60+		-56.1	-53.1	-46.1	-76.1	-50.8	-51.4	-61.0	-70.0	-48.5	-65.9
<i>Castes</i>											
Scheduled Caste		-52.6	-53.6	-52.4	-71.1	-50.0	-50.7	-64.8	-70.2	-47.2	-76.3
Scheduled Tribe		-39.9	-53.7	-49.4	-66.7	-37.4	-39.2	-53.5	-70.3	-38.3	-63.2
Other Backward Classes		-55.1	-49.0	-53.4	-74.9	-54.8	-55.8	-69.4	-69.2	-50.9	-78.6
Other		-59.7	-53.1	-57.3	-75.3	-59.3	-59.3	-63.1	-77.1	-55.4	-77.3
<i>Religion</i>											
Hindu		-51.9	-50.2	-51.8	-73.3	-49.9	-50.5	-62.5	-69.5	-46.9	-74.8
Muslim		-51.9	-51.3	-49.8	-66.6	-52.0	-52.6	-64.4	-72.4	-47.6	-73.5
Christian		-60.4	-59.1	-52.2	-83.1	-58.9	-59.9	-61.1	-79.6	-57.2	-73.3
Other		-56.5	-57.6	-52.3	-78.3	-56.3	-59.9	-53.0	-76.1	-55.6	-76.5

*Notes*

i. All figures presented in Table C.4 is based on author's calculation with NFHS 3 (2005/6) and NFHS 4 (2015/16) data.

ii. The t-statistics for difference show that the absolute and relative changes are statistically significant at 1% (\*\*\*) for national, rural and urban areas, states and all population subgroups.

iii. Relative change in censored headcount ratio is defined as the relative change in the proportion of people who are multidimensionally poor and deprived in a given indicator between 2015/16 and 2005/6 as a percentage of the initial level of deprivation.

iv. \*Andhra Pradesh includes the state of Telangana; Pujab includes the state of Chandigarh (see Appendix B for details).



## Appendix D

Table D.1 20 MPI trials using India NFHS 2015/16 - 2005/6

	Trial	Specifications revised	Population size	N poor	MPI	H	A
2015-2016	0	old MPI specification	1,324,171	379,279,712	0.127	28.64	44.45
2005-2006			1,161,978	665,134,656	0.304	57.24	53.08
			<i>changes</i>		-0.177	-28.60	-8.63
2015-2016	1	6 years of schooling	1,324,171	400,378,560	0.137	30.24	45.35
2005-2006			1,161,978	680,272,704	0.317	58.54	54.19
			<i>changes</i>		-0.180	-28.31	-8.84
2015-2016	2	6 years of schooling & under 18 child mortality past 5 years	1,324,171	351,754,784	0.116	26.56	43.77
2005-2006			1,161,978	626,717,568	0.276	53.94	51.13
			<i>changes</i>		-0.159	-27.37	-7.36
2015-2016	3	6 years of schooling & child nutrition solely using stunting measure	1,324,171	384,383,712	0.132	29.03	45.46
2005-2006			1,161,978	667,728,640	0.312	57.46	54.21
			<i>changes</i>		-0.180	-28.44	-8.76
2015-2016	4	6 years of schooling & under 18 child mortality past 5 years & child nutrition solely using stunting measure	1,324,171	336,179,040	0.112	25.39	43.99
2005-2006			1,161,978	612,729,216	0.270	52.73	51.23
			<i>changes</i>		-0.158	-27.34	-7.24
2015-2016	5	6 years of schooling & child nutrition using stunting for under 2 & underweight for >=2 years	1,324,171	381,615,008	0.131	28.82	45.39
2005-2006			1,161,978	664,885,056	0.310	57.22	54.15
			<i>changes</i>		-0.179	-28.40	-8.76
2015-2016	6	6 years of schooling & child mortality past 5 years & child nutrition using stunting for under 2 & underweight for >=2 years	1,324,171	334,736,640	0.111	25.28	43.96
2005-2006			1,161,978	610,722,112	0.269	52.56	51.21
			<i>changes</i>		-0.158	-27.28	-7.26
2015-2016	7	6 years of schooling & child nutrition using stunting or underweight measure	1,324,171	395,009,120	0.136	29.83	45.55
2005-2006			1,161,978	672,999,936	0.315	57.92	54.31
			<i>changes</i>		-0.179	-28.09	-8.77
2015-2016	8	6 years of schooling & child mortality past 5 years & child nutrition using stunting or underweight measure	1,324,171	348,036,608	0.116	26.28	44.11
2005-2006			1,161,978	619,713,664	0.274	53.33	51.36
			<i>changes</i>		-0.158	-27.05	-7.25
2015-2016	9	6 years of schooling & child nutrition using stunting & housing 1 out of 3 components + assets include computer & animal cart	1,324,171	397,594,400	0.136	30.03	45.31
2005-2006			1,161,978	677,206,400	0.315	58.28	54.13
			<i>changes</i>		-0.179	-28.25	-8.82
2015-2016	10	6 years of schooling & child mortality past 5 years & child nutrition using stunting & housing 1 out of 3 components + assets include computer & animal cart	1,324,171	350,642,656	0.116	26.48	43.84
2005-2006			1,161,978	623,674,816	0.275	53.67	51.17
			<i>changes</i>		-0.159	-27.19	-7.33

## 20 MPI trials using India NFHS 2015/16 - 2005/06 (cont.)

	Trial	Specifications revised	Population size	N poor	MPI	H	A
2015-2016	11	6 years of schooling & child nutrition using stunting & housing 2 out of 3 components + assets include computer & animal cart	1,324,171	354,446,784	0.121	26.77	45.27
2005-2006			1,161,978	652,575,552	0.301	56.16	53.66
<i>changes</i>				-298,128,768	-0.180	-29.39	-8.39
2015-2016	12	6 years of schooling & child nutrition using stunting for under 2 & underweight for >=2 years & housing 1 out of 3 components + assets include computer & animal cart	1,324,171	394,793,344	0.135	29.81	45.24
2005-2006			1,161,978	674,263,744	0.314	58.03	54.07
<i>changes</i>				-279,470,400	-0.179	-28.21	-8.83
2015-2016	13	6 years of schooling & child mortality past 5 years & child nutrition using stunting for under 2 & underweight for >=2 years & housing 1 out of 3 components + assets include computer & animal cart	1,324,171	347,631,040	0.115	26.25	43.79
2005-2006			1,161,978	620,575,104	0.273	53.41	51.12
<i>changes</i>				-272,944,064	-0.158	-27.15	-7.33
2015-2016	14	6 years of schooling & child nutrition using stunting for under 2 & underweight for >=2 years & housing 2 out of 3 components + assets include computer & animal cart	1,324,171	351,985,952	0.120	26.58	45.21
2005-2006			1,161,978	649,628,352	0.300	55.91	53.61
<i>changes</i>				-297,642,400	-0.180	-29.33	-8.40
2015-2016	15	6 years of schooling & child nutrition using stunting or underweight measure & housing 1 out of 3 components + assets include computer & animal cart	1,324,171	408,636,928	0.140	30.86	45.40
2005-2006			1,161,978	682,496,448	0.319	58.74	54.23
<i>changes</i>				-273,859,520	-0.178	-27.88	-8.83
2015-2016	16	6 years of schooling & under 18 child mortality past 5 years & child nutrition using stunting measure & housing 1 out of 3 components + assets include computer & animal cart	1,324,171	349,167,168	0.116	26.37	43.82
2005-2006			1,161,978	622,681,600	0.274	53.59	51.13
<i>changes</i>				-273,514,432	-0.158	-27.22	-7.32
2015-2016	17	6 years of schooling & child nutrition using stunting or underweight measure & housing 2 out of 3 components + assets include computer & animal cart	1,324,171	364,546,368	0.125	27.53	45.37
2005-2006			1,161,978	657,609,600	0.304	56.59	53.77
<i>changes</i>				-293,063,232	-0.304	-29.06	-8.40
2015-2016	18	6 years of schooling & under 18 child mortality past 5 years & nutrition using only child anthropometric data, ie stunting or underweight measure & housing 1 out of 3 components + assets include computer & animal cart	1,324,171	281,062,912	0.094	21.23	44.09
2005-2006			1,161,978	502,141,824	0.219	43.21	50.65
<i>changes</i>				-221,078,912	-0.125	-21.99	-6.56
2015-2016	19	6 years of schooling & child nutrition using stunting or underweight measure & housing 1 out of 3 components + assets include computer, animal cart & ownership of 10ha of land	1,324,171	408,574,944	0.140	30.86	45.39
2005-2006			1,161,978	682,496,448	0.319	58.74	54.23
<i>changes</i>				-273,921,504	-0.178	-27.88	-8.84